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PESTICIDES AND RISK COMMUNICATION

Interaction and Dialogue with the Public

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PURDUE PESTICIDE PROGRAMS

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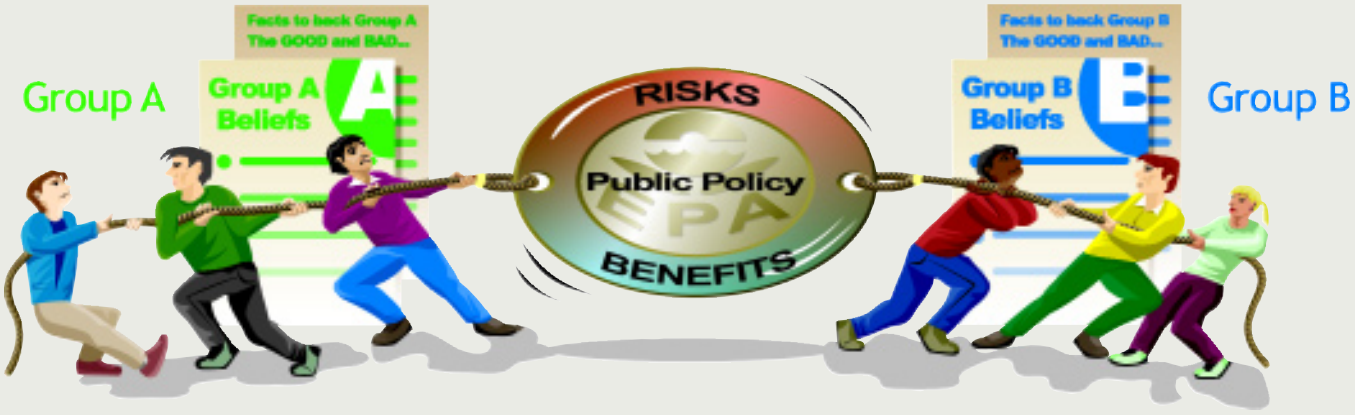
Introduction

Communicating the complex and controversial topics surrounding pesticides is challenging, and there is no shortage of issues, information, and opinion. There are no magic words or secret recipes for communicating a fair, informed message; and there are no prescriptive rules for educators to follow.

Although no communication rules exist, the battle to win the hearts and minds of consumers goes something like this: After many painstaking hours of searching through government files, pesticide testing results, and public policy documents, Group A determines that the United States government and pesticide manufacturers are subjecting children to unnecessary risk. Group A calls a press conference to announce that, based on their findings, pesticides in our children's diet pose serious health concerns. The press conference concludes with the rhetorical question, Can *any* risk to our children be justified when we do not know all of the (potential) adverse effects that pesticides may have on them?



Group B's experts, who say that the risk to children is very low and that government standards are set to exceed all likelihood of adverse effects, quickly refute Group A's arguments. They say that Group A uses scare tactics in citing invisible, imaginary, and theoretical risk. Group B calls Group A's report "junk science," claiming that their conclusions are based on faulty assumptions; that the data are misunderstood and misused; and that their report was neither peer-reviewed nor published in a reputable scientific journal. They counter Group A's additional argument—that there are effective alternatives to pesticides available for controlling weeds, insects, and diseases that threaten farmers' crops—with the realization that pesticide use remains a necessary component in assuring an abundant, affordable, and reliable U.S. food source.

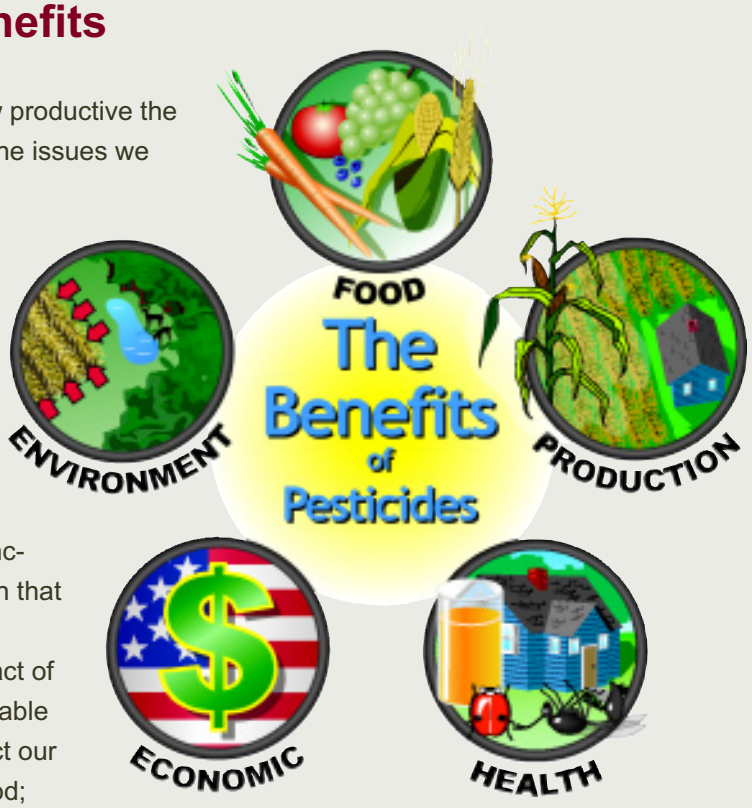
The public draws from these sound bites and headlines in forming opinions on the benefits and risks that pesticides pose. They are left to judge which group of dueling experts is more credible and which has the consumer's best interest at heart. The critical role of the educator in this plight is to help consumers cut through volumes of technical, contradictory, and sometimes frightening information in concluding where to place their confidence.

The issue of consumer (mis)understanding is major. Consumers are asked to make increasingly difficult risk decisions for themselves and their families, based on complex scientific and technical information. This publication outlines the history of commercial pesticide development and regulation and describes the educator's role in helping the consumer form an educated opinion.

The History of Public Debate on Pesticides

The Early Years: A Public Focused on Benefits

A review of the early years reminds us how productive the debate has been and piques our concern for the issues we face today. When commercial pesticides were first used in agriculture in the 1930s and 1940s, the public in general welcomed and applauded them. DDT, the first widely used and recognized synthetic pesticide, was of such obvious benefit that it spurred the development of new pesticides for use in the home, on the farm, and in the workplace. The benefits of pesticides were easily demonstrated and observed—and very convincing. There prevailed a strong public conception that technology could solve all problems.



Food. Pesticides reduce the negative impact of pests on crop production and facilitate sustainable yields on fewer acres of farmland. They protect our crops, our stored grain, and our processed food;

they contribute significantly to our abundant, high quality, economical food supply.

Pesticides are an integral part of the crop production equation that enables one American farmer or rancher to produce enough food to feed more than 100 people per year. It takes less than 2 percent of the American work force to produce enough grain, meat, and fiber to feed the nation, freeing the remaining 98 percent to pursue other vocations.

Health. Pesticides control pests at home, school, and work. They reduce the incidence of waterborne and insect-transmitted diseases such as malaria and West Nile virus; protect consumers against potentially lethal toxins in molds; protect pets from fleas and ticks; and facilitate vegetation management on rights-of-way, which contributes to safer transportation and reliable electricity transmission.

Wildlife and the environment. Pesticide use on fertile farmland increases production, facilitating the return of marginal farm acreage to wildlife habitat. Pesticides protect the diversity and quality of natural habitat by controlling invasive, non-native species. Pesticides also contribute to improved water quality and aquatic habitat by reducing soil erosion: they control weeds in no-till farming systems, where the soil is not disturbed (to erode) by disking.

Economics. Pesticide manufacturers, users, industries, and associated businesses contribute positively to the balance of trade, provide good-paying jobs, and provide a tax base to support local, state, and federal governments.

As we contemplate pro-pesticide arguments, today, we recognize their similarity to those of the past. Perhaps the most significant *difference* is the audience: today's consumers are more suspicious—even pessimistic. The public is less willing to accept the premise that pesticides are beneficial, overall. They are wary of scientific authority and less willing to accept and rely on the positive without knowledge of the negative. They want substantiated proof that the benefits outweigh the risks.

USDA Regulations and Product Registration

In 1947, shortly after World War II, the United States Department of Agriculture (USDA) was required under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) to register all pesticides and establish standards for label content. Within USDA, the Pesticide Regulation Division (PRD) was assigned the responsibility of registering pesticide products and was divided into the Registration Branch and the Enforcement Branch.

The Registration Branch was responsible for registering all products before they entered the market. Manufacturers wishing to register a product had to

- provide efficacy data demonstrating product performance.
- substantiate their claim that the product met USDA safety and health criteria.
- document truth in labeling: that the contents of the product were exactly as stated on the label.
- include clearly stated use directions, on the label, to assist the user in gaining maximum benefit from the product.
- describe, on the label, the use precautions necessary to ensure human and environmental safety.

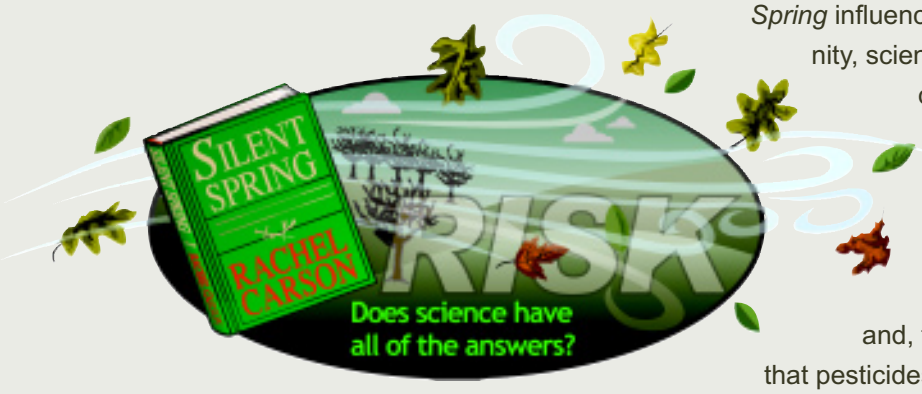
Government involvement continued to increase. In 1958, the Food and Drug Administration (FDA), through the Miller Amendment, worked with USDA to set tolerances for residues in food. Thus, manufacturers were required to submit data to show that pesticide residues in food from treated crops did not exceed established tolerances. During this period, most tolerances were around 7 *parts per million,* which corresponded to the sensitivity limit of analytical methods available at that time. Pesticides *without* detectable residues were assigned a "no residue" registration; and those *with* detectable residues were assigned a "residue" registration.

The residue/no-residue registrations were challenged as improvements in technology allowed scientific detection of residues in *parts per billion.* This increased capability raised concerns because pesticides previously registered through USDA as "no-residue" products could now be shown to render residues detectable in *parts per billion.* The result was elimination of the "no-residue" registration.

FIFRA was amended in 1964 to require USDA to refuse registration of pesticides determined unsafe or ineffective, and to revoke registration of and remove such existing products from the market. It also requires that all pesticide labels bear a USDA registration number; that the front label of all pesticides display a signal word—CAUTION, WARNING, or DANGER—and the phrase "Keep Out of Reach of Children"; and that all claims made about the "safety" of a product be removed from the label.

Rachel Carson Introduced the Public to Pesticide Risks

In 1962, Dr. Rachel Carson published *Silent Spring,* a book that refocused and energized public debate on pesticides. Carson was a scientist with the U.S. Fish and Wildlife Service, and in her book she described the devastating effects of DDT on the environment. *Silent*



Spring influenced the public, the farming community, scientists, and government officials to quit thinking of pesticides as miracle chemicals and acknowledge the danger they posed to wildlife. From that time on, the terms *risk* and *environmental pollutant* were linked to pesticides; and, for many, the preconceived notion that pesticides were "good" was replaced with serious doubt.

Reactions to Carson's book set into motion a wave of public participation in the political debate on pesticides. Environmental advocacy groups drew public attention to associated risks, while industry and trade associations continued to extol the benefits of pesticide use. Congress became the middleman, and lines were sharply drawn for a debate that continues today.

The impact of *Silent Spring* went far beyond the eventual banning of DDT in 1971. The book legitimized public concern and public participation in decisions on pesticides. *Silent Spring* made people realize that their government was not necessarily telling them the whole story. Suspicion of government was heightened as advocates made themselves heard, and there was a major shift in how society perceived science and scientists: technology was viewed skeptically and more critically.

Integrated Regulation: Creation of the Environmental Protection Agency

In 1972, public outcry on environmental pollution in general—and pesticides in particular—gave rise to a new federal agency: the U.S. Environmental Protection Agency (EPA). Responsibility for enforcement of FIFRA was transferred from USDA to EPA, and the focus of federal pesticide policy shifted from controlling the quality of pesticides used in agriculture to *the reduction of unreasonable risk to human health and the environment.*

In addition, the authority to establish pesticide tolerances for food was transferred from the Food and Drug Administration to EPA, placing the agency in full control of the pesticide registration process.

Public Policy Sets the Stage for Rules Governing Pesticides

It is interesting that the development of policy to correct one potential problem—unreasonable risk to human health and the environment—in fact fueled additional pesticide concerns. This cause and effect scenario shaped key historical decisions from which pesticide rules and regulations have emerged.

- The furor surrounding pesticides marked them for extensive governmental scrutiny. FIFRA was amended by regulation to protect human health and the environment; and with EPA responsible for the regulation of pesticides from registration to final disposal, critics had but one agency to target.
- The party in power appoints EPA's upper management personnel; and their decisions in turn reflect political influence. All decisions are public.
- EPA must decide how to implement public policies that meet the imprecise definition of *safe.* As defined by Congress, *safe* means that when the product is used according to its label it will not cause "unreasonable adverse effects on human health or the environment"; and that there is "reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue, including all anticipated dietary exposures and all other exposures for which there is reliable information."

What on the surface seems to be a clear and reasonable definition of *safe* is actually quite murky. What is *reasonable certainty?* What effects are unreasonable? One person's definition of *safe* can be another's definition of *dangerous.* For example, a homeowner who uses pesticides in her garden may view them harmless—that is, *safe*—except to targeted pests; but the neighbor who watched his pet die after ingesting a pesticide might consider them *dangerous.* Regulatory interpretation lies with each generation of policymakers who command their own historical, political, and scientific perspectives. What was deemed unacceptable in the past may be viewed as acceptable or even desirable, now; and what is acceptable, today, may not be, tomorrow.

- EPA is responsible for both environmental research and environmental regulation, but it is often faulted for failing to fulfill these obligations.
- EPA requires pesticide manufacturers to perform numerous tests and to submit data in support of their product for registration. The

data are evaluated to determine whether use of the pesticide will adversely affect human health or the environment. Even so, a degree of risk remains because testing cannot identify absolutely all risks nor answer every question that may arise. Registration data are scrutinized by consumers, manufacturers, and scientists looking for evidence to challenge EPA's interpretations.

- Decisions on pesticides are based on the premise that human health and the environment are not adversely affected by low-level exposure. But what level is *safe?* The level of minimal risk has to be determined for each and every product, and the responsibility lies with EPA to interpret scientific data and assign safe exposure levels.
- An EPA registration is not a recommendation for, nor an endorsement of, the product registered. It simply indicates that, based on its evaluation of available data, EPA considers the product safe for use according to label instructions. But there remains the possibility that others might interpret the exact same data quite differently; so it is easy to see that registration can be perceived as endorsement, particularly by groups that oppose the registration of a given product.
- Restricted-use pesticides may be legally purchased and used only by certified applicators and those who work under their direct supervision. Certification signifies that an individual has demonstrated (by testing and/or training) the competency to handle pesticides safely and judiciously.
- EPA is shaping the pesticide marketplace by encouraging the development, registration, and use of reduced-risk pesticides and by accelerating the registration process for biological control agents and other products that meet *low risk* criteria: low toxicity in test animals and nontarget organisms; short-term persistence in the environment; low potential to contaminate surface and ground water; low risk of human and environmental exposure; and compatibility with integrated pest management strategies. It is noteworthy that the implementation of this reduced risk policy places EPA in a position to promote one pesticide over another.
- Pesticide regulations in any given state may differ from federal regulations. That is, federal law constitutes *minimum* requirements, but states are given the latitude to impose more stringent pesticide regulations as they see fit; i.e., some states may elect to be more "protective" than the federal government.
- The product label is the main avenue of communication between the pesticide manufacturer and the user—and the best source of safety information. EPA bases its registration decisions on the premise that users follow label instructions: there is no alternative. The pesticide label is a legal document, and any use of a product inconsistent with its labeling constitutes *mis*use. The label may be

cited as the basis for enforcement actions such as fines, probation, and license revocation; and it is often questioned why EPA and its state counterparts do not police pesticide applications more diligently to deter or identify misuse incidents.

- Pesticide manufacturers are required by law to report (to EPA) any problems associated with their products. This requirement facilitates follow-up on products that impact human health and the environment adversely. But although the law *requires* manufacturers to report suspected problems, they are trusted to do so *voluntarily.*

An Overview of the Registration Process

Manufacturers spend millions of dollars on product research, countless hours working on EPA registrations, and even more energy advertising in the marketplace. There is infinite pressure on manufacturers to develop new products and to meet EPA registration requirements. But their products must generate enough revenue to return the initial investment and earn profits for the company and its shareholders.

Manufacturers must supply scientific evidence that a pesticide, when used as directed by the label, will not injure humans, crops, livestock, and other nontarget organisms or the environment, and that it will not produce illegal residues on or in food and feed. The steps manufacturers use to meet these requirements are complex and lengthy.

Generation of chemicals for screening. Traditionally, companies have synthesized thousands of novel chemicals for testing every year; and for every successful new compound they produce, dozens prove unworthy and are scrapped. The attrition rate has risen sharply over the years.

Primary screening. Most manufacturers use a screening process to identify chemicals with pesticidal properties. The impact on growth, development, behavior, and mortality of pest insects, weeds, and diseases is carefully observed and recorded.

Secondary screening. Compounds that survive primary screening go through a secondary screening process wherein proven, reliable predictors of biological and environmental properties are used to identify negative chemical attributes.

Patenting. Companies apply to the United States Patent Office for a patent to protect their interests with respect to compounds and methodologies they have developed. The process can take several years.

Testing according to EPA protocol. New chemicals that pass the secondary screening process are then tested extensively, according to EPA protocol. Manufacturers must conduct and analyze research under EPA Good Laboratory Practices (GLPs), which are procedures for extensive documentation and verification of every step of the testing process.

EPA application. After several years of testing, the registration data package is submitted to EPA. The package includes test results on acute, chronic, reproductive, and developmental toxicity of the pesticide and its major breakdown products; ecological studies to determine harmful effects on nontarget plants and animals; and environmental fate studies to determine rates at which the pesticide breaks down, and whether it moves off target.

Product registration. Under FIFRA, a product is assigned a registration number only if supporting data indicate that the probability of risk to people, wildlife, and the environment is minimal. If the registration package and the corresponding risk analyses are acceptable, registration is granted.

Product labeling. The label is part of registration. It provides product information, use directions, and other pertinent information for applicators, such as hazards, precautionary statements, first aid, and storage and disposal requirements.

Commercial introduction. A product must bear an EPA-approved label before the registrant can introduce it for sale in the United States; and only then does the registrant begin to recover the cost of product development.

State registration applications. Most states require manufacturers to register all products used within their respective boundaries. Several states utilize registration processes similar to those of EPA; but in some

states the registration of a product with an approved federal label is simply a matter of paying a fee.

Even after a pesticide product survives the rigorous registration process, its success is uncertain. A pesticide prevails only if it works, if it is accepted, if its use is widespread, and if it turns a profit for the manufacturer. And each step is filled with uncertainty.

EPA's Evaluation of Risk After Registration

The purpose of EPA's initial pesticide registration process is to determine whether or not public policy guidelines and data from scientific tests support the registration of a product in the United States. EPA also requires that directions be provided on the product label to ensure safe use by the applicator, but their responsibility does not end with registration. EPA also must follow the product in the marketplace to answer questions such as, What if the product is misused and the directions not followed? What happens if problems arise after the product has been registered?

The registrant must report to EPA any suspected adverse effects that come to the attention of its employees or agents. Adverse effects include any anecdotal information brought to the attention of company representatives. It is the suspicion of a *new effect* that triggers a response, not a *new adverse effect.* Suspected new effects typically are those witnessed in field-use situations, such as detection of a pesticide in surface and ground water, property damage from pesticide drift, human poisoning, and injury to nontarget organisms. Adverse effects can include those resulting from the pesticide's inert ingredients, metabolites, contaminants, and impurities, or from the active ingredient(s). Manufacturers must report any information that might raise concerns about the continued registration of their pesticide products.

The Public's View of Pesticides

Risk assessment is based on a complex mix of perceptions, social considerations, and science. Consider the true example of an applicator who was observed pouring a herbicide from a 55-gallon drum into his sprayer without wearing gloves and safety glasses as required by the label. When asked why he was not wearing the safety equipment, he responded, "This stuff's not so bad. My children are all right. It didn't

hurt them, so it won't hurt me." When asked whether he'd allow photographs to be taken while doing his work, his response was, "Yes, but let me put on my safety gear"! The point is that people's perceptions of a purely physical phenomenon—the hazard—are not solely a function of the hazard but, instead, the product of hazard, experience, and risk tolerance. In this example, the applicator was more worried about what others might think than about any danger presented by the hazard.

Personal Judgments Reflect More than the Facts

Deciding whether or not to make (or contract for) a pesticide application may be likened to deciding whether or not to have surgery! You must evaluate the risk factor—high, low, or moderate—and weigh it against the projected benefits.

The physician can easily describe the surgical procedure and the invasiveness of the surgical technique, inform you of the potential complications and side effects, project the odds on partial or full recovery, and estimate the long-term prognosis. But his view is subjective: he will not be undergoing the procedure *himself.* As the patient, you have to consider elements such as cost, quality of life, comfort level before and after the operation, risk potential, and your confidence in both the physician and the diagnosis. You (the customer) and the physician (the professional) view the surgery from two different vantage points, each in the context of your own knowledge and experience. In deciding what to do, you must weigh his professional opinion against your own perception of the consequences.

Judgments about pesticides are more complex than simply understanding government risk assessments, reports, charts, and figures. It is one thing to read that the risk is being managed, but it is a quite another to realize that your neighbor has allowed a pesticide to drift onto your property.

A representative study of Indiana residents (non-farmers) and farmers clearly illustrates that our vantage point affects how we view pesticide risk. Farmers have a vested interest: pesticides make farming easier and increase crop productivity/profit. And indeed the study (Table 1) illustrates that farmers are less concerned about pesticide risk than are citizens whose need for and use of pesticides is limited—and whose income is not directly affected. Overall, Indiana residents are more fearful of pesticides than are farmers. Who is right? It all depends on the vantage point: Who is faced with risk? Who manages the risk? and Who benefits from pesticide use?

Table 1. Perceptions of Risks from Pesticides[1]	Residents	Farmers
Are the risks of pesticides understood by the public? (1 = Risk known precisely; 7 = Risks not known)	5.9	5.5
Is the risk of death from pesticides immediate, or is death likely to occur at some later time? (1 = Effects immediate; 7 = Effects delayed)	5.9	5.5
Do pesticides pose risks for future generations? (1 = Very little threat; 7 = Very great threat)	5.2	3.7
Is the risk from pesticides new and novel or old and familiar? (1 = New; 7 = Old)	4.9	4.6
Do people face the risks of pesticides voluntarily? (1 = Voluntarily; 7 = Involuntarily)	4.8	3.9
Are the risks from pesticides increasing or decreasing? (1 = Decreasing greatly; 7 = Increasing greatly)	4.8	3.7
Pesticide risk affects how many people in your community? (1 = Few; 7 = Many)	4.6	3.5
To what extent do the benefits from using pesticides make up for any risk of using pesticides? (1 = Benefits make risk okay; 7 = Risks make benefits unacceptable)	4.3	2.7
How easily can the risk from pesticides be reduced? (1 = Easily reduced; 7 = Not easily reduced)	4.3	3.8
Can pesticides cause large-scale death and destruction across the whole world? (1 = Low potential; 7 = High potential)	4.2	2.8

(continued)

Table 1. Perceptions of Risks from Pesticides[1]	Residents	Farmers
Are you at risk from pesticides? (1 = No risk; 7 = Great risk)	4.1	4.0
Can you control your risks from pesticides? (1 = Cannot control; 7 = Can control)	3.9	5.1
When there is a mishap or illness from pesticides, how likely is it that the consequences will be fatal? (1 = Certainly fatal; 7 = Not fatal)	3.9	4.6
Is the risk from pesticides a risk that people have learned to live with and can think about reasonably, or is it one that people are afraid of? (1 = Live with; 7 = Afraid of)	3.7	3.9
Is the risk from pesticides one that kills people one at a time or a risk that kills a large number of people at once? (1 = One at a time; 7 = Large numbers)	3.5	2.6
Are the risks of pesticides known to science? (1 = Known; 7 = Unknown)	3.5	3.6
Can the risk of pesticides be controlled by preventing accidents or by reducing what happens after an accident occurs? (1 = Prevent before; 7 = Control after)	3.0	2.6
Are the harmful effects of pesticides easily seen by the public? (1 = Not easily seen; 7 = Easily seen)	2.2	2.6

[1]Source: R. A. Feinberg, F. Whitford, and S. Rathod. Perceived risks and benefits from pesticide use: The results of a statewide survey of Indiana consumers, pesticide professionals, and extension educators.

The Real Issue

We make judgments based on our values and experiences, on the information available, and on the credibility of our source. Ideally, we should gather all the facts before passing judgment: to use or not to use; to allow or to ban. But everyday situations often provoke spontaneous decisions, even without all the facts and even when an immediate response is unnecessary. Risk communicators—people in a position to influence others for or against pesticides—must provide enough of the right information for audiences to make informed decisions.

For instance, a high school freshman doing a science project asked 50 people if they would sign a petition demanding strict control or total elimination of the chemical dihydrogen monoxide—and for plenty of good reasons:

- It can cause excessive sweating and vomiting.
- It is a major component of acid rain.
- It can cause severe burns in its gaseous state.
- It can kill if aspirated.
- It contributes to erosion.
- It decreases effectiveness of automobile brakes.
- It has been found in tumors of terminal cancer patients.

Forty-three of the people surveyed said yes, six were undecided, and one said no; yet, if the student had called dihydrogen monoxide by its common name—water—the results would have been a unanimous no. Perception and context are critical to good judgment.

The Real Conflict: Pesticides Are Safe and Unsafe

Pesticides are used to kill or alter the behavior of certain organisms. They are beneficial, yet they pose risk. So, what are the dangers from any particular pesticide? How many organisms are at risk? Are we willing to accept the risks in pursuit of the benefits? These questions have to be addressed and, ultimately, EPA must decide what constitutes acceptable risk. It's difficult to do because there is a fine line between *safe* and *dangerous.* The issue is not only whether pesticides are dangerous, but also to whom or what they are dangerous, and to what degree.

Where Is the Line Between Safe and Unsafe?

Risk *assessment* and risk *management* are vital in determining the *level* of risk posed by a given pesticide. EPA's current policy is that the risk assessment process should identify methods and criteria for estimating the level of risk. The policy also mandates release to the public of all scientific information on which EPA bases its conclusion.

Risk assessment is the science-based process of quantifying and characterizing risk, that is, estimating the likelihood of occurrence and the nature and magnitude of potential adverse effects.

Risk *management* is the process by which judgments and decisions are made on the acceptability of the level of risk identified during risk assessment. Risk managers must integrate the results of risk assessment with social, economic, and political factors. They may classify a product for restricted use; lower application rates; restrict the number of applications; increase application intervals; stipulate longer intervals between application and harvest (in agriculture); or prescribe alternative application methods. These measures often take the form of label changes designed to reduce the amount of pesticide used or to lower human exposure potential. They may even decide not to register the product.

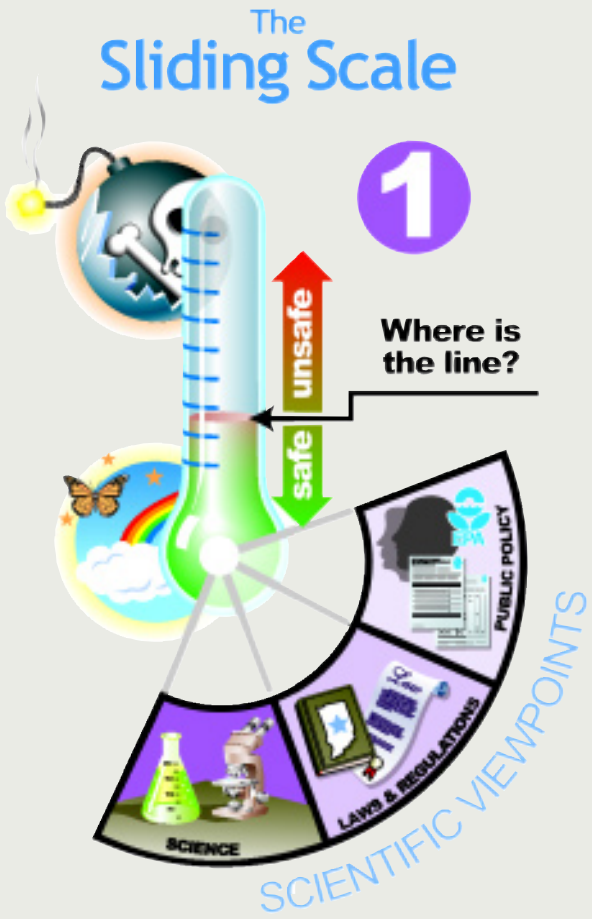
Uncertainty About Where the Safety Line Should Be Drawn

Safety determinations are based on scientific information and public opinion as to what constitutes acceptable risk. But science is not exact: there are uncertainties in evaluating the safety of any substance,

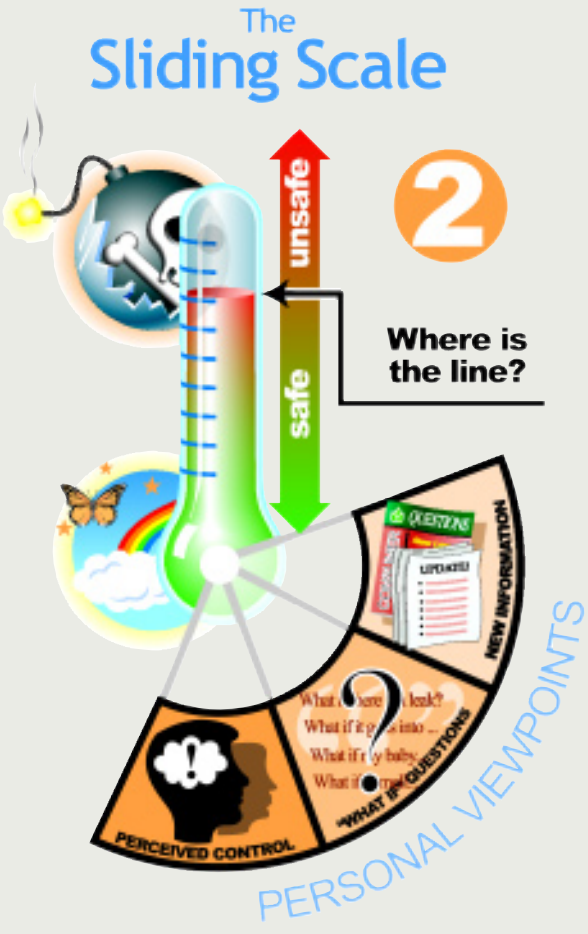
including pesticides. EPA must incorporate scientific information, policy guidelines, and professional judgment in estimating whether a pesticide can be used beneficially within the limits of acceptable risk.

A product is assumed safe from a scientific point of view if associated risks are minimal. However, the following four points must prevail to substantiate that assumption:

- Conditions must not change to the extent that the assumptions and methods used in the supportive risk assessment may be rendered invalid.
- The user must follow label directions explicitly.
- The product must perform as anticipated, once it is released into the environment.
- Use of the product must not create adverse effects previously undetected in lab and field test data used for risk assessment.



Can the Line Be Drawn at All?

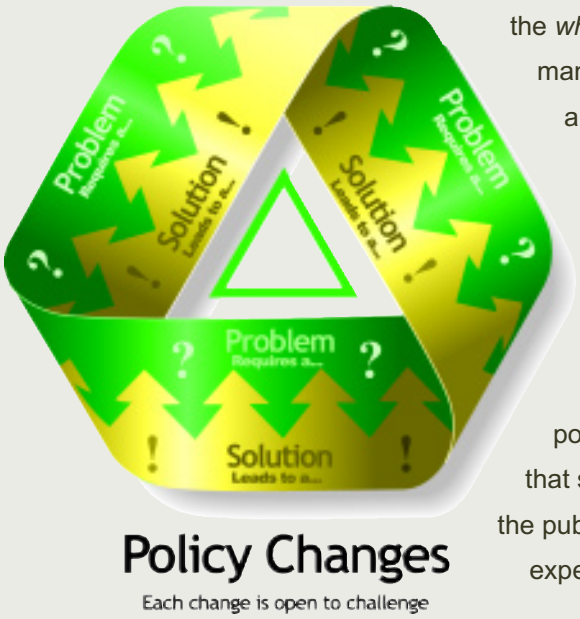


When asking where to draw the line, start with the question, Is it safe? In reality, we will never know with complete certainty that a pesticide is or is not *safe:* the line between *safe* and *dangerous* is never as defined in real life as it is in science. Pesticides are developed to work with reasonable certainty and minimal risk. But they exist in a world of *what ifs* that loom outside the realm of verifiable scientific information; and often it is the what ifs that alert policymakers to data gaps.

Based on evaluation of the best data available on a pesticide at a particular point in time, scientists can state in all honesty that no significant problems exist with it. But in reality there are many reasons why we may never know whether it is safe under all circumstances, nor can we predict with certainty its performance in hypothetical or future situations. Scientific investigation is bound by the tools and techniques available, and new developments continually redefine our capabilities.

Pesticide manufacturers are required by EPA to present extensive scientific data in support of products submitted for registration. But science can go only so far in addressing pesticide issues. The more data we have, the more questions we ask—and science often stops short of definitive answers. Problems can span many disciplines, e.g., medicine, chemistry, and biology, which makes solutions evasive.

We will never know if pesticides are safe in the absolute sense of the word. Science may never define safety, nor prove it. But the *what if*s will continue to drive regulatory agencies, manufacturing, marketing, public interest groups, application industries, judicial processes—and science. And there is an interesting, unintended side effect.



The fact that data analyses are disputed among scientific, government, and industrial interests cultivates a public mind-set of distrust and disbelief. On one hand, we extol the power of science; on the other hand, we caution that science cannot answer the *what if*s. We school the public to rely on experts, but we caution them that experts disagree!

It is questions like these that challenge risk communicators:

- Do we know all the right questions to ask to establish data requirements for all pesticide registrations?
- Why are products registered when science cannot answer my questions?
- Why should someone else decide whether I am exposed or not?
- If EPA says that product registration is not an absolute guarantee of safety, then what does registration mean to me?
- Why can't EPA guarantee that its decisions will ensure no harm?
- Why does EPA rely on the manufacturer's data on their own products in making registration decisions?

So, can the line be drawn? The answer is yes, but it may have gaps.

From a distance, the line may look solid; but, up close, you may see spaces: spaces that represent the information we *do not* and *may never have.* The line between *safe* and *dangerous* is drawn only as definitively as our knowledge allows, and it is the uncertainties that challenge researchers and educators alike.

The Art and Science of Risk Communication

Professionals who make their living managing risks and hazards think principally about the physical characteristics of substances. If the hazard they manage is a pesticide, they think about its toxicity and volatility, its effectiveness in controlling the target pest, the likelihood of its contaminating ground water, its persistency in the environment, etc.

In contrast, when people have concerns regarding hazards managed by *others*, they tend to think less about the substance itself and more about personal impact, fairness, and control. If the hazard is a pesticide, people may worry about whether there are pesticide residues in or on the foods they buy, or whether their children are exposed to pesticides at school. Those who fear exposure to a hazard beyond their control may be justifiably concerned: Why am I or my children being exposed?

The following table summarizes factors shown to influence risk perception. These factors help to explain why farmers or commercial applicators who have used pesticides for years might perceive their risk lower than would urbanites who view pesticides as unnatural, nonbeneficial, and beyond their control.

Questions About the Product	Positive Perception (viewed as less risky)	Negative Perception (viewed as more risky)
Who makes it?	Occurs in nature	Man-made
Who benefits from it?	I do	Others do
How important are the benefits?	Compelling	Vague
Is the risk familiar?	Yes	No
Are effects immediate?	Yes	No (delayed)
How serious are the effects?	Not very	Dramatic
Is exposure controllable?	Yes	No
Who controls my exposure to it?	I do	Others do
Is there visible risk?	Yes	No
Is its use a moral issue?	No	Yes
Has it ever received memorable media attention?	No	Yes
Is my exposure voluntary?	Yes	No
Is there a fairness issue?	No	Yes
Are there scientific answers?	Yes	No
Is the risk old or new?	Old	New
Who does it affect?	Not me	Me
Where is it used?	Not in my backyard	In my backyard
Is the risk controllable?	Yes	No

We Say Risk, They Hear Danger

Every day, we make presentations on risk that are right on the money, but sometimes we are dismayed by questions from the audience. For example, you lead a discussion on the level of risk posed by pesticide residues in food and drinking water. You discuss how laboratory animals are exposed to pesticides and how the toxic response in the mother and the fetus is evaluated. You state that, under most circumstances, detectable pesticide residues in food do not cause birth defects.

But, as you conclude, a pregnant woman asks, What is the bottom line? Can these levels cause birth defects in my unborn baby? You say the odds are low, but what about my baby? *So how did she miss that? Why didn't she hear what you said?*

Actually, she did hear you, but she does not feel in control. What she "heard" was that *someone else has control over her personal level of exposure.* So the risk to her and her baby looms larger than if she herself were in control. She wants more assurance that her baby will not be the one in a million who is affected.

Another person asks, How can it be safe to eat fruits and vegetables if they have pesticides on them? Don't pesticides kill or injure living organisms? Do you really know the effects of consuming food that contains pesticide residues?

You point out that the scientific consensus is that the benefits of eating a diet rich in fruits and vegetables far outweigh the risk of ingesting pesticide residues. The person listens politely, but you can tell by the look in his eyes that he doesn't believe a word you are saying, and then comes his rebuttal: It just doesn't make sense. How could eating pesticides be good for you?

Then someone in the front row says he read in a magazine or saw on television that even small amounts of pesticides can impact a child's hormone system, and that there is scientific proof that some children have developed learning disorders and behavior problems as a result of pesticide exposure. He related the story of young Mexican children who had been exposed to pesticides and could not draw pictures like unexposed kids their age. He said that his retired neighbor, a pediatrician, said that pesticides also have been proven to cause leukemia.

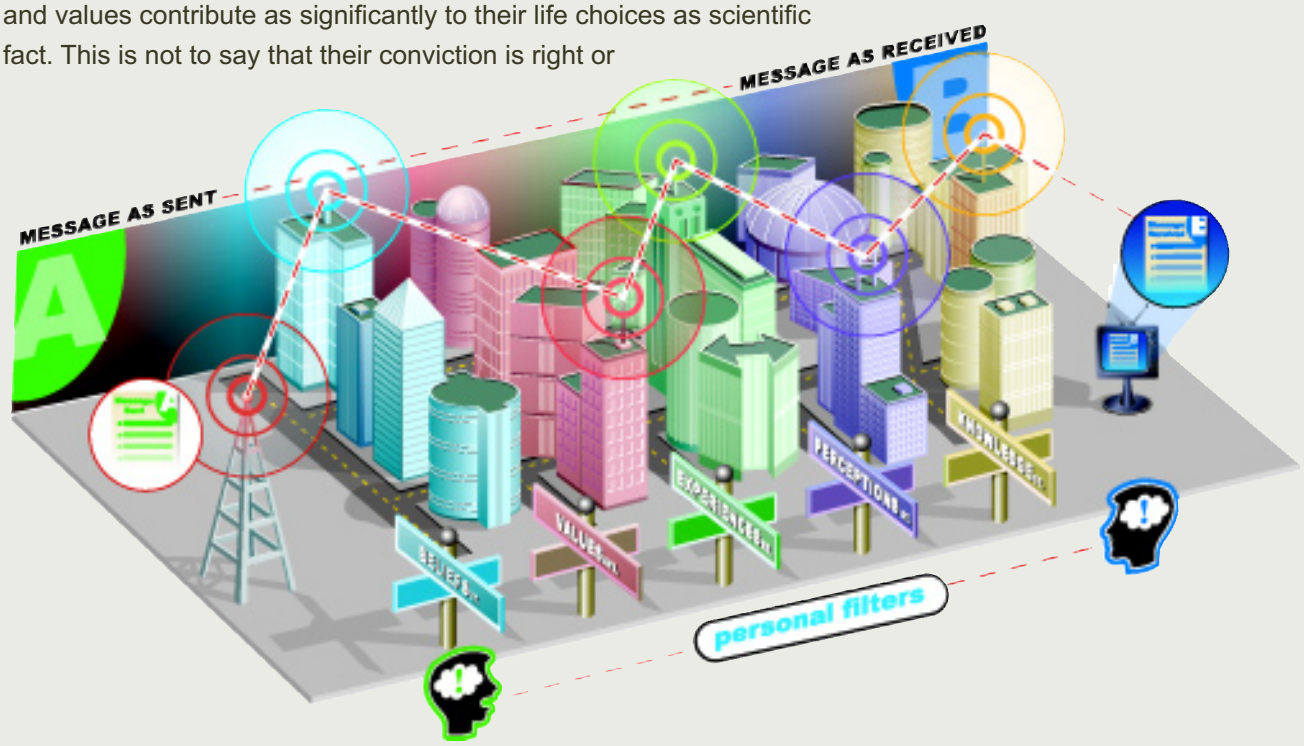
He wants to know how you can claim that pesticides detected in or on food are insignificant when the chemical has been scientifically proven harmful. He questions how you can be certain that trace levels pose no risk to his grandchildren and to that woman's unborn baby. And *you* wonder why he does not acknowledge the complexities of science and how difficult it is to answer his questions with a definitive yes or no!

You have the facts, and you have already explained how we know that any risk posed by registered pesticides on food is low and that the

odds of someone reacting adversely are minuscule. So why hadn't these people listen to what you said? Why are they questioning your information and expertise? Why are they looking for a guarantee when nothing we do is risk free?

People smoke and think nothing of being overweight. They skip their annual physicals and seek medical attention as infrequently as they can. They fly. They drive—even *drink and drive!* They invest long, stressful hours in their careers. They ingest tons of chemicals known as prescription drugs. Many have multiple sex partners. Yet they worry about trace levels of pesticides in their food? Why does science have so little impact?

The simple answer is that people's experiences, perceptions, beliefs, and values contribute as significantly to their life choices as scientific fact. This is not to say that their conviction is right or



wrong: we all see things from our own point of view. But people tend to want total assurance against negative consequences of pesticide use, and that is simply impossible.

A representative survey of Indiana residents shows the magnitude of danger citizens associate with pesticides (and there is no reason to believe that Hoosiers are any more or less fearful than citizens in other parts of the country). Citizens were asked to rate on a scale of 1–7 how fearful they are of various potential risks: 1 = I am not very afraid; 7 = I am very afraid.

Pesticides used on farms ranked in the most-feared category along with nuclear accidents, pollution, smoking, handguns, nerve gas, auto accidents, and chain saw accidents. It can be derived from this response that pesticides spell catastrophe in the minds of many; and it is easy to understand why weak explanations and exclamations of pesticide safety have minimal positive impact on the public mind-set.

Do you fear the following?

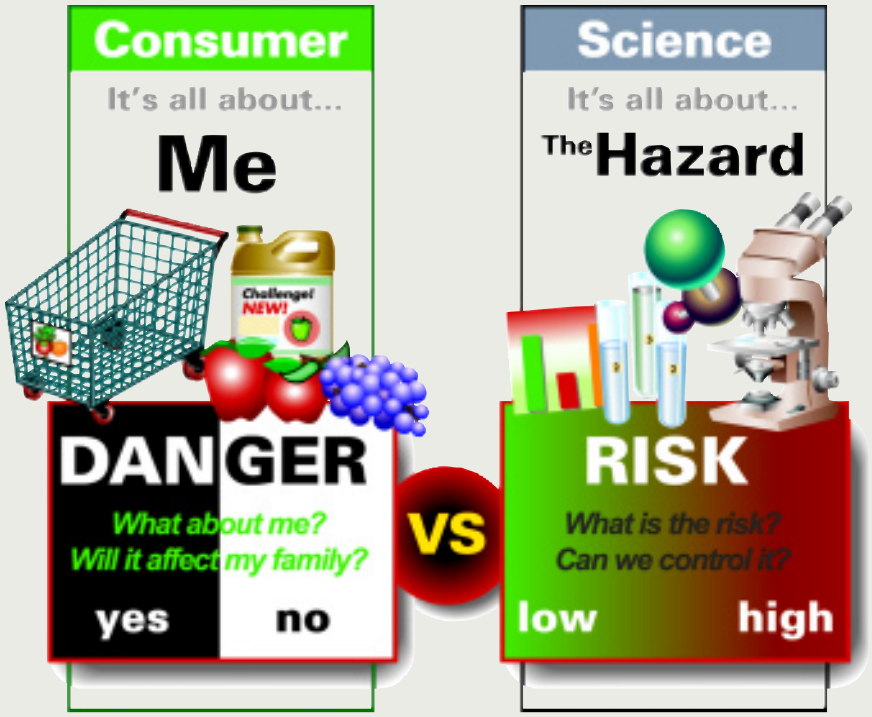
Respondents were asked to rank their fears on a scale of 1 to 7: 1 = I am *not very* afraid; 7 = I am *very* afraid.

Activity/Technology	Resident Responses
Nuclear accident	5.6
Pollution	5.4
Smoking	5.3
Hand guns	5.1
Nerve gas accident	5.0
Auto accident	5.0
Food tampering	4.8
Pesticides used on farms	4.8
Chain saws	4.6
Auto exhaust	4.5
Pesticide use in homes	4.1
Fireworks	4.1
Pesticides use in the garden	4.0
Biotechnology	3.5
X-rays	3.0
Caffeine	2.4
Microwave ovens	2.4
Water fluoridation	2.4
Antibiotics	2.3
Bicycles	1.7

There is a second aspect of this that makes communication difficult: Scientists view pesticide risk as a professional issue; but consumers look at it as a danger imposed on them by others. For example, the probability of getting injured or killed by a handgun is remote. But you cannot convince a person with a handgun pointed at his temple that the risk is low. In much the same way, it is difficult to convince some consumers that the risk posed by pesticide residues on food is low. Similarly, it is difficult to convince those who feel comfortable using pesticides around home or on the job to take extra precautions.

Public Policy Decides Societal Risk

Risk is the chance of injury, damage, or loss; the degree or probability of loss; the act of exposing oneself to a risk or taking a chance. And scientists and government officials address risk in terms of probability for *populations,* not individuals.



Individuals Personalize Risk

Risk, to the scientist, is a continuum from low to high—not an absolute. Individuals hear the word *risk* and think *danger.* The word *danger* is defined as *a thing that may cause injury, pain, etc.*

Each of us personalizes *danger* relative to any phenomenon that has the possibility of injuring us, our family, our community, or our environment. Our interpretation is based on our own experience, lifestyle, and expectations. The critical question is whether the risk is important or dangerous to us or to people or things we care about.

The Foundation of Communication

Communicating about pesticides and associated risks often is an uncomfortable process. As William Dury once said, "When your views on the world and your intellect are being challenged, and you begin to feel uncomfortable because of contradictions, and you have detected what is threatening your current model of the world or some aspect of it, pay attention—you are about to learn something." If everyone followed Dury's advice, risk communication would be simpler!

Generally, before people are receptive to risk information, they must believe that the source of that information is credible and fair. So, when designing our message to convey pesticide risk, we must understand

the communication difficulties that our audience may face. In risk communication, there are five common barriers listed in the mnemonic CAUSE:

- Lack of Confidence
- Lack of Awareness
- Lack of Understanding
- Lack of Satisfaction
- Lack of Enactment

First, risk communicators often confront suspicion, so they need to employ strategies that earn the *confidence* of their audience. Second, risk communication often is impeded by unfamiliarity with the subject, so the communicator must create *awareness* of the scope of information available. Third, because risk communication involves concepts that may be difficult to grasp, communicators need to ensure that their audience is *understanding* the message: information should be presented at the audience's level, from the audience's vantage point. Fourth, *satisfaction* with solutions is critical: Risk communicators must offer plausible precautionary approaches to risk management. Fifth, the audience must be stimulated toward *enactment;* that is, the risk communicator must deliver the message so that the audience will embrace and implement his recommendations.

Good communicators depend on research and experience for overcoming obstacles described by the mnemonic CAUSE. These obstacles must be addressed in order: C-A-U-S-E. For instance, *Understanding* cannot be addressed until the risk communicator has earned the audience's *Confidence.*

Earning Confidence: Working with the Audience

People are often skeptical of large companies, big government, or any organization that wields power. So when representatives of academia, government, or industry offer assurance relative to pesticide safety, their effectiveness may hinge on trust—or lack of it.

Trust pertinent to risk management is earned by acknowledging people's fears and providing information on which they can base their own informed choices. It is molded by competence and character: *Competence* is a matter of relevant expertise, while *character* is reflected by the integrity and fairness of the individual.

Trust in an individual—a risk communicator—begins with a good first impression. If your audience perceives that you care about their well-being, they will trust what you tell them. But trust is best earned by matching words with actions.

Reflecting the Audience's Perception

The best way to reach an audience is to address their concerns. When you commit to making a presentation, ask the program sponsor to identify any uncertainties the audience might have about the subject for discussion; then develop your message to fit their need.

On the day of the program, arrive early and mingle with the group; talk with people and determine what is on their minds. Acknowledge their concerns at the beginning of your presentation, to capture their attention, and follow through by addressing them.

If people are mostly frightened or upset about pesticides, offer whatever information you can to ease their minds. Talk about ways they can exercise some degree of control over pesticide applications. Explain how they can contact government officials to express their concerns; identify groups that share and can assist in projecting their opinions; and offer tips on monitoring pesticide use. On the other hand, if your audience is generally supportive of pesticides, you can focus more on risk education than on empathy.

Sorry, But I Need to Run

Every program has the speaker that “runs”: here one minute, gone the next. He arrives with only a minute to spare; talks for an hour without taking questions; and then says, Sorry, but I must leave for important business. Never be that person: set a better example.

As mentioned previously, it is important and effective to spend some time talking with people and listening to their concerns before your presentation. But it is equally important to field questions from the audience during your wrap-up, and to stay through the next break to talk with folks who didn’t want to ask questions in front of the group. Pass out business cards and encourage people to call you later if they think of additional questions. Going out of your way to make yourself available adds credibility to the message just delivered. Never tell an audience that you must leave immediately after your presentation; it sends the message that something else is more important.

Don’t Be Held Hostage by the Lectern

The lectern separates you from the audience, so break the barrier by stepping away from it. Whenever possible, walk into the group so that you are *among* them. Ask the program sponsor (well ahead of time) to provide a hand-held microphone with an extended cord or a wireless mike that will allow you to escape the podium prison!

Experience Means More than Degrees

After being introduced by the moderator, greet your audience and let them know, briefly, what qualifies you to speak on the topic. But don’t talk about your background in terms of educational degrees. Academic credentials may imply credibility, but it is your own involvement—your own personal experience in the field—that adds credence to your message.

Be Confident

Speaking with confidence builds trust, but cockiness has just the opposite effect. This is one reason why it is important to practice your presentation in front of people whose opinions you value, and whom you can trust to offer honest feedback.

$5 Words Do Not Impress

Clarity instills trust, so use common language. If the audience doesn’t understand your message, you will lose them; so keep your

message simple and to the point. Don't risk sounding evasive or arrogant, and don't be a know-it-all!

Be Courteous

Courtesy demonstrates respect and can earn you the trust of your audience. As you draw people into your presentation, be aware of cultural differences and be careful not to embarrass anyone. A word or gesture meant to embellish your talk may offend someone, out of context, so be very cautious; a remark gone wrong is a high price to pay to make a point or to generate a laugh. And remember: The genuine, old-fashioned handshake is still an effective method of recognition that tells people you are pleased to see them and interested in what they have to say.

Address People by Name

Addressing people by name is an effective way to connect with the audience. At many programs, each person wears a name tag. Call people you know, by name; but if the person to whom you are speaking is not a friend or acquaintance, address them by their last name preceded by Mr. or Ms. When someone asks a question, ask his name and use it in response.

Listen to Others

A true expert is always interested in learning about others' experiences relative to his field. So be a good listener. Wherever you go, ask people to share their personal knowledge on pesticides and pesticide management. They may add a local twist that you have not encountered elsewhere—and you might learn something! People love to tell their own tales, and your interest in what they have to say will establish good rapport and expand your expertise.

Answer Questions

Some speakers instill audience participation by taking questions throughout their presentation. But this approach works for some speakers and not others. It serves people who cannot focus on whatever else you have to say unless and until they get their question answered, but it can be distracting for you and others. Also, questions breed questions; and it is easy to get caught up answering questions and deplete your allotted time without addressing everything you had planned.

If you cannot maintain your momentum when fielding questions, simply tell your audience, up front, that you will leave plenty of time for

questions and answers following your presentation. Then do so. Never tell them you will, and then not.

Listen

Do not interrupt a question. It's rude. Many times, the core of the question is expressed last, so don't anticipate that you already know what it is. Let the asker finish. Then, make sure you understand the question, think about it briefly, and repeat it for the whole audience before you address it. Give an honest reply. If you need a few seconds to organize your thoughts, throw in something like "That's a very good question" or "Good point!" or "The point of your question is actually quite important." It will buy you a little time and make the asker feel good; it might even encourage others to ask questions.

What They Asked Was . . .

When someone asks a question, make sure you understand what is being asked. If it is lengthy, quickly summarize it and confirm that you understand exactly what the question is. Then, repeat it succinctly into the microphone to ensure that everyone in the audience has heard it. This approach serves not only to clarify the question; it also gives you a short window of time to compose your response.

Acknowledge Their Feelings

When people start a question with *I feel,* your first comment should be to acknowledge their feelings. Begin your response with a personal statement such as *I understand how you feel.* There are not always good answers to emotional questions, but at least acknowledge the person's concerns. Try to draw out their underlying fears; often they can be calmed, at least in part, by fact. Provide the facts of the situation they describe, and explain issues associated with their concern. Try to balance their apprehension with extenuating circumstances typical of the real world trade-offs we face.

Admit When You Don't Know

People appreciate honesty, so don't try to fool them when you don't know the answer. If you offer a best guess response, qualify it by *admitting* that it is your best guess. If you just do not know the answer, simply admit it. Get the person's name and write the question down; follow up, later, by researching the question and getting back to the person with a response.

What Do You Think About That?

Draw on the experiences of others in the audience. Ask how they would answer the question or solve the problem posed. This demonstrates to the asker that situations can be approached from different points of view. It helps them gain a better understanding of the complexity of the issue. Once you and others (if solicited) have answered, ask the person if their question has been addressed satisfactorily. If not, get their name and phone number and follow up, after the program.

I'm Here to Help

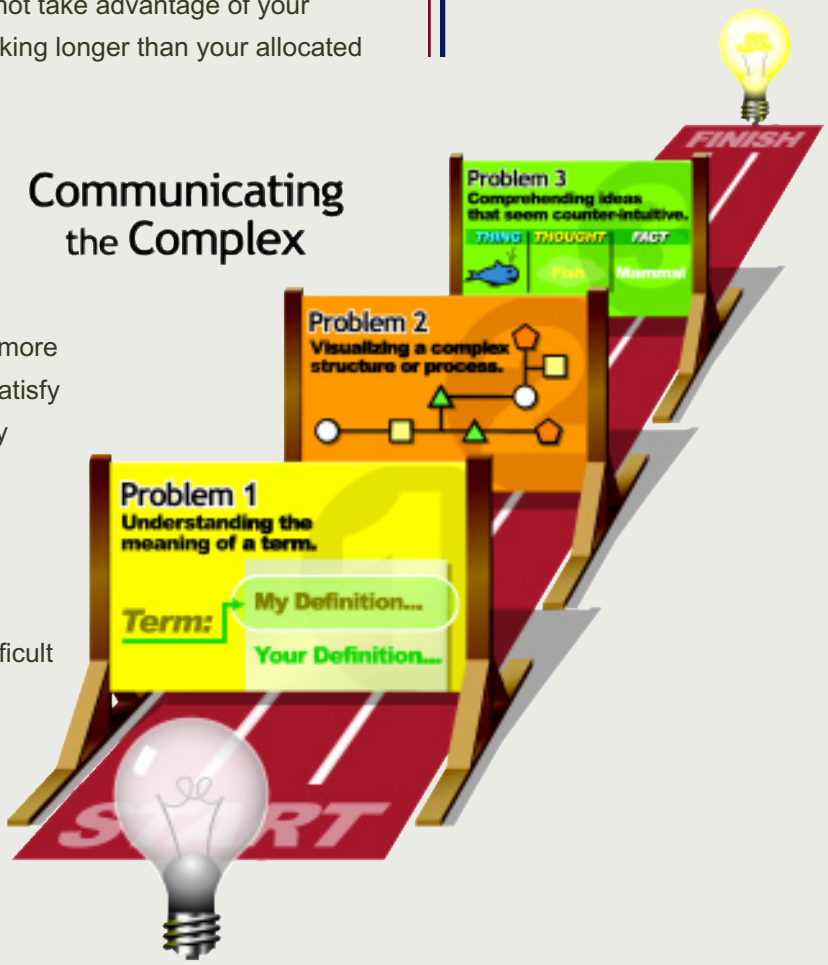
Let people know that you can be reached whenever they have questions. Announce that you will leave a few business cards in the front of the room for those who might like to contact you. Express not only your availability, but also your sincere interest.

Respect People's Time

People watch the clock, so always finish up slightly early to allow for questions and thoughtful responses. Do not take advantage of your audience and program sponsors by speaking longer than your allocated time.

The More They See You, The More They Trust You

Trust is developed when you perform a task reliably over a period of time. The more times you address the same group and satisfy their concerns, the more comfortable they become with you.



Explaining the Difficult

Three major facilitators in grasping difficult concepts have been identified:

- Understanding the meaning of common terms
- Visualizing a complex structure or process
- Comprehending ideas that seem counter-intuitive (not instinctive)

Explaining Essential Meanings of Commonly Used Words

Research in instructional design shows that people master a word or concept by learning to distinguish its meaning *as intended by the communicator* from other associated but unintended meanings. According to many studies, this learning process is most likely to occur when a person's attention is called to the distinction between the intended meaning and the unintended meaning. For example, a communicator might remind an audience that the term *chemical,* within the context of her presentation, means *chemical compounds comprising everything in the universe.* In advertising, on the other hand, the word *chemical* sometimes refers only to manufactured substances injected into food. The distinction is critical to the essence of her message.

There are many, seemingly familiar words that may be misinterpreted in discussions on pesticides. When people hear the word *risk,* for example, they may think *danger.* But Purdue University ethics professor Paul Thompson advises that risk communicators should tell audiences that the word *risk* means *probability*—not danger—relative to pesticides. Risk communicators use the words *pesticide, chemical,* and *science* routinely and may assume that their audiences recognize them in context; but in actuality they may not. As an example, the term *pesticide* often refers to farm chemicals; but disinfectants, although technically considered *pesticides*, are rarely thought of as such. Risk communicators should define key words to assure understanding.

Explaining Complex Structures or Processes

Complexities that are difficult to envision also can be obstacles to comprehension. For example, difficulty arises when people try to understand why a tumor develops under some circumstances and not others; how a company is going to create a safer pesticide; how genes that code for pesticides can be inserted from a bacterium into a corn plant; or what a risk of *one part per million* means. Given the latitude for misunderstanding, always assist your audience in comprehending key terms and concepts referenced in your presentation.

Studies in educational psychology have identified many techniques effective in helping people build mental images: pictures, diagrams, and analogies are particularly useful. Other effective strategies are preview statements ("The four key steps in protecting yourself when using pesticides are . . .") and scenarios (how hormones function . . . why DDT persists in fatty tissue).

Analogies and comparisons that simply make an abstract notion more concrete, familiar, or visual can be very helpful. For example, you might help an audience understand the importance of dosage in determining pesticide risk, with this example: You take a bottle of aspirin and it kills you. You take two aspirins, you feel better. You take just a little flake of one and you feel nothing, even though you have detectable levels in your body. This analogy can be used when trying to explain why low pesticide exposures encountered in the workplace, in food, and in drinking water do not necessarily cause harm.

Explaining Implausible and Counter-Intuitive Ideas

A third source of confusion lies with ideas that are hard to understand because they are counter-intuitive. These scientific ideas frequently conflict with deeply held lay theories. For instance, some people have difficulty believing that exposure to any pesticide level is safe or that pesticides can be used safely in schools. The conflict between lay and scientific accounts can lead people to reject, ignore, or misunderstand fundamental aspects of science which can affect their health and safety.

Like scientists, people in general do not give up their theories easily. Consequently, explanations that help people question lay notions must

- state the common view,
- acknowledge its apparent legitimacy,
- present an alternative viewpoint, and
- describe why the scientific view has merit.

For example, how does one explain why otherwise healthful foods contain natural toxins? Following is an account of the hard-to-believe notion that many foods contain natural pesticides.

State the common view. It seems reasonable to believe that natural foods are comprised of entirely healthful substances.

Acknowledge the apparent legitimacy of the common theory. There are many good reasons for believing natural foods are good for us. Clearly, eating healthful food is associated with well-being, and many elderly people credit healthful eating for their longevity. Personal experience tells us we feel better when we eat a balanced diet.

Present the alternate viewpoint. However, it is not the case that all things *natural* are healthy. We know that some mushrooms are poisonous, that forests can contain poison ivy, and that simply eating too much food is bad for us. So, perhaps we should not be too surprised to learn that healthful foods such as fresh baked bread, shrimp, potatoes, and peanuts may contain natural toxins and human carcinogens.

Describe why the scientific view has merit. Why would natural toxins exist in foods? Plants produce these toxins to protect themselves

from their natural enemies: diseases, insects, and predators. For example, aflatoxin is a known human carcinogen. It is a natural toxin produced by fungi that form on (and contaminate) stored products: wheat, corn, nuts, and carbohydrate foods such as peanut butter. Aflatoxin also is found in the milk of cows that eat moldy grain. In essence, the idea that natural foods contain *only* healthful substances is unsound.

As this example shows, the key to good explanation of counter-intuitive ideas is recognizing that people with deeply held theories they do not reject them easily. These theories exist because they seem to work. So, good communicators need to acknowledge that such theories are apparently reasonable.

However, we cannot simply reject a common theory by way of a good explanation. Instead, as in the example, the explanation must remind an audience that their theory does not account for certain phenomena. In this example, people are reminded that some natural entities—such as poison ivy—are harmful.

In summary, as good risk communicators, we must diagnose situations before communicating. They identify the principal difficulties in risk communication situations—the obstacles—and consider steps to overcome them. Most importantly, we know that trust must be earned before education can occur.

The Myths of Risk Communication

The following myths of risk communication are adapted from Chess, C., B. Hance, and P. Sandman. 1987. Improving dialogue with communities: A short guide for government risk communication; untitled work by Thomas J. Hoban, North Carolina State University.

Myth 1: There is not enough time and resources for communicating about pesticides. Risk communication does take time and staff. Nevertheless, if you do not make an effort to interact with the public, you may be forced to deal with communication disasters that typically take even more time and resources to fix.

Myth 2: Communicating with the public about risk is likely to alarm people. Risk communication itself can be risky, but not giving people a chance to express their concerns is more likely to *increase* alarm than decrease it. Balanced communication of pesticide benefits and risks is more likely to *decrease* public concern.

Myth 3: If we could only explain risks clearly enough, people would accept them. Although explaining risk is important, there are many factors beyond our control that influence individual perceptions of risk.

Myth 4: We should not go public until we have solutions to the problems. There may be some logic in the notion that problems are better accepted when coupled with solutions; but, when you get right down to it, the public wants a say in their own destiny. They want to be apprised of the negatives as well as the positives. They want the chance to voice their own opinions. And sometimes they propose solutions that the experts have not considered!

Myth 5. These issues are too difficult for the public to understand. Issues can be complex. Nevertheless, citizen groups throughout the country have demonstrated that lay people are quite capable of grasping difficult concepts associated with complex, scientific issues. We cannot communicate successfully by talking down to the public: they become justifiably angry.

Myth 6: Technical decisions should be left with technical people. Technical personnel may be well versed, scientifically; but policy is determined not only on the basis of science but also public values. And an informed public is more likely to reach a sound decision than one that is not.

Myth 7: Risk communication is not my job. True, you probably were hired on the basis of other credentials, but you still have a responsibility to deal with people. Failure to communicate may result in policy that damages good science.

Myth 8. Interest groups are responsible for stirring up public concerns. Activists work to bring about change. They do not create the concerns; they merely arouse and channel attention to those that already exist.

Risk Communication in Practice

Our radio and television programs are interrupted with the following weather update: A tornado watch is in effect. Conditions are right for a tornado to occur in our area within the next fifteen minutes. Prepare to take shelter immediately.

So, why don't we? Why do fifty percent of us ignore the alert? Why do we normal, perfectly sane people—scientists included—dismiss or totally ignore this kind of information? Why don't we take shelter?

Why do we ignore safety advisories on the use of seat belts, helmets, and chemical resistant gloves? Why do we ignore our doctors' advice to lose weight for the sake of our health? The list is endless.

The mystery as to why risk messages have little or no impact is one of the many puzzles facing social scientists today. And it is even more

puzzling with regard to *pesticide risk* because the science is complex and unclear: there are no simple answers.

Messages that communicate pesticide risk often run counter to prevailing or logical beliefs. For whatever reason, most people have a preconceived belief that pesticides are either safe or risky. And any message that claims otherwise is likely to be dismissed without consideration. The emotions attached to pesticides—My children are in danger! or, I won't be able to maintain the family farm if pesticides get taken off the market!—set up mental roadblocks to logical judgment. Moreover, there are many well-spoken, well-respected people who reinforce the inherent tendency to believe that pesticides are either safe or dangerous.

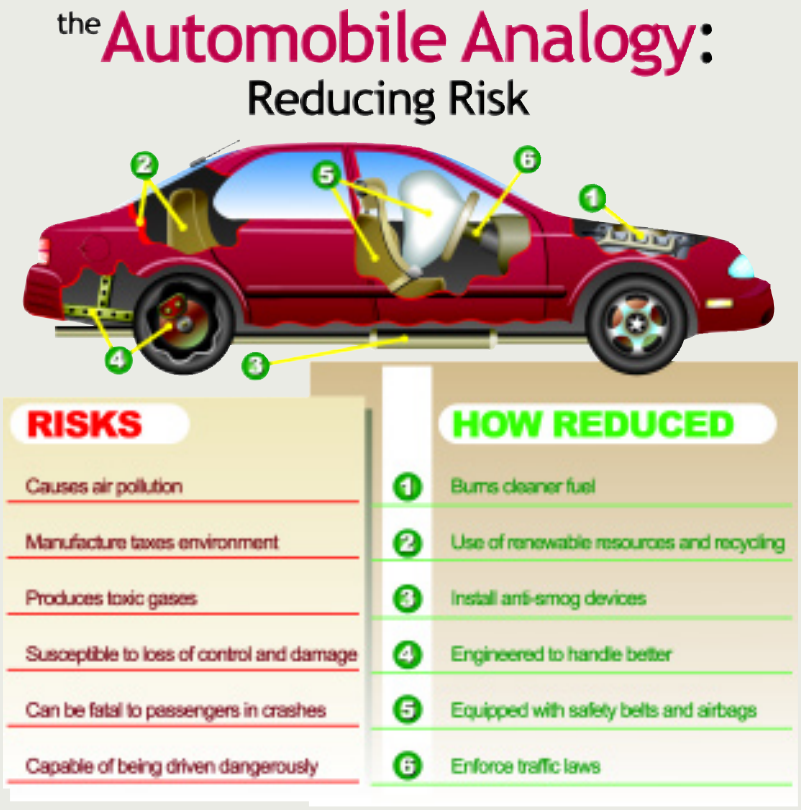
It is complicated and difficult to effectively communicate the trade-offs associated with pesticide use. Unlike directions to someone's house, they just cannot be drawn on a map: numerous communication and psychological difficulties are attached.

To illustrate, give an audience the following information on a hypothetical product and ask for their reactions. The product

- contains a chemical that causes cancer in laboratory animals.
- causes serious injury to millions of people.
- kills 40,000 people a year.
- kills millions of animals a year.
- causes fires when ignited.
- requires tremendous resources for production.
- causes major air pollution problems.
- produces toxic gases.
- causes billions of dollars in property damage every year.
- destroys millions of acres of land for roads to facilitate it.

When presented with this information, the public unanimously agrees that the product should be banned immediately. But divulge to the same audience that these facts are actually linked to the automobile, and their reaction is just the opposite. The risks are accepted, then, because the car is part of the American way of life; because individuals believe they have control over the risks; and because there is no good alternative to the automobile.

The public is quick to discuss how government, industry, and advocacy groups have worked to reduce risks associated with the automobile. The



public demands, via pressure for legislation, that gasoline burn cleaner, that cars be equipped with anti-smog devices, and that alternative renewable resources (e.g., electric batteries) be explored. They have prescribed that we utilize mass transit systems; that government set air quality standards; and that cars be engineered for increased mileage. Manufacturers incorporate safety features such as seat belts and air bags; public service announcements warn us not to drink and drive; and law enforcement officials arrest us for driving while under the influence of alcohol. Clearly, the public sees both sides to this story and is able to arrive at decisions on the dangers of driving an automobile by weighing both the benefits and the risks. In contrast, unfamiliarity with pesticides makes it more difficult to encourage the careful management of associated risk.

There are no formulas, magic bullets, or workshops on how to master the art of communicating and educating people on the trade-offs that pesticides pose. Communicators who want to deliver an effective message to the public must be prepared with supporting facts, must develop trust with the audience, and must convey a balanced message.

These simple components of persuasion are required whether the message is presented in writing or in person; and whether the intent of the message is to teach, inform, inspire, persuade, or entertain. Risk communicators can succeed by using common sense in presenting risk information to an individual, to a small group, or to a national audience.

Their message must be

- fairly portrayed.
- balanced.
- accurate, clear, and concise.
- easily understood.
- respectful of the audience's values, beliefs, and perceptions.

The Old Way Doesn't Work Anymore

Most risk communicators have backgrounds in science or public administration. However, seldom does the person writing or speaking on pesticide issues have professional training in the art of communication. Most risk communicators learn their skills through trial and error, by observing others, or from on-the-job experience. But whatever you do, don't make the following mistakes.

Don't Just Talk

Can you remember the last time you witnessed a highly respected scientific expert addressing a group, talking nonstop, then running out of time? How many presentations lack a concise summary? How often do speakers fill the time slot without time for questions and answers? Very bright people—experts—often give speeches as though they were in school: They present the facts, using graphs and figures. They discuss their findings but offer no speculation. They limit their conclusion to the facts and often leave no time for questions.

Don't Ignore Your Audience

Scientific presentations that work at professional meetings usually fail when presented to the general public. Your qualifications as an expert are not the last word on the subject; and speaking before a group and quoting scientific assurances does not necessarily resolve an issue. Sometimes there are no absolute answers.

The public has views and opinions that may or may not oppose those of scientists, government policymakers, and elected officials. And while their objections and arguments may have nothing to do with the facts as presented, they do reflect public sentiment on the issue.

Today's communication experts acknowledge that it is critical to develop a relationship between themselves and their audience and to recognize and respect various interests among the group; otherwise, what they say will not be heard, nor will what they write be read.

The Public should be an equal partner with the Scientist

Personal Preparation: Know What You Are Talking About

Preparedness is the backbone of effective communication. Do your homework and know your subject—or don't even bother!

I Didn't Study That in School

Knowing more about pesticides than your audience knows does not make you "the expert." Pesticides represent a complicated area of study, and even the most seasoned professionals in the field may not be experts; typically, their expertise is in only a small subpart of the issue. So know your stuff!

He Says, She Says

We often imply that scientists agree on the facts in their field, i.e., that science speaks as one voice. But nothing could be further from the truth. In fact, it is common for reputable, well-known scientists to *dis*-agree!

Do not be selective in assembling evidence to support your stance. An important aspect of risk communication is to understand and appreciate the spectrum of scientific opinion on the subject, particularly when fronted by ingrained attitudes. Research shows that fixed attitudes can be modified only through balanced persuasion. If you do not present a reasoned discussion to an audience that has an adamant attitude *counter* to your message, that audience will react against your argument and intensify their belief to the contrary.

I've Summarized the Research

Be sure to read and review articles written for scientific journals by leading experts in the field. These works are essential reading because they merge published literature (past and present) and often project future needs. They also provide citations that will lead you to additional scientific literature on the issue. Authors do not always refer to the same literature base; so for a balanced perspective, read all you can find on the subject.

That Research Sure Set the World on Fire

Keeping up-to-date is vital. Be ever mindful of what is hot in the media. Read published articles and other scientific literature, and research the issue on your own. Learn as many details as you can. Generally, people focus on the headlines, so go beyond that. Equip

yourself with additional information and be prepared to speak intelligently on the issue when asked.

I'm Not "the Public," I'm Me

Individuals form a group because they share common values and objectives, but that does not mean that each person thinks like the others on all issues. Each individual has their own unique interests, needs, concerns, and level of knowledge on the subject; so avoid categorizing extreme positions on either side of the issue. The majority in most audiences will take a wait-and-see attitude. They will listen to facts and conclusions and weigh the merits of your risk analysis before forming their opinion.

Be Smarter Than the One

There is almost always a person in the audience who understands the fine details of the pesticide issue—possibly better than you do! So stay at the top of your game; fumbling with the facts in front of an audience means losing face. Be well read, attend specialized workshops, and ask the experts plenty of questions to fend against problems with the complexities of communicating risk management.

Been There, Done That

There are facts you get from reading, and there are facts you get by seeing and doing. Work with the groups to whom you normally speak. Observe what they do and how they do it. Try to understand how they think. Take plenty of photographs and use them in your presentations to show the audience that, although you might not be one of them, you are making an effort to view the issue from their perspective. However, be careful not to assume by virtue of having visited a few times and taken pictures that you know *exactly* what they are experiencing. Get to know your audience. Get a feel for the particular group, their issues, and their concerns. You may need to fluctuate communication strategies, depending on your audience. Try to find at least one common thing that you can personally identify with to help bridge the gap between yourself and your audience.

People Don't Want to Know All You Know

Don't let details get in the way of education. Every issue has crucial baseline facts, but it is critically important to separate the *have-to-know certainties* from the *nice-to-know details.* The more information you

provide, the more you must explain—and the greater your chance of losing the audience to a sea of information: Your message may not get through!

Cull the most important points from your subject matter and present them as simply as you can. Give your audience enough information to form their own opinions, but do not fuss with “but it depends” qualifications. Save the nonessential, nice-to-know details for the question and answer period, and interject them skillfully into your responses.

Know that Science Cannot Answer All Questions

If you were writing a book on any pesticide issue, some chapters would be blank due to lack of data or to conflicting scientific interpretation of available data. Be honest about uncertainties; be very careful about promoting your own interpretations; and always let the audience know when you are speculating or when available data are inconclusive.

What’s Your Point of View

Audiences want unbiased information, but they also expect to hear your view on the risks that pesticides pose. If asked directly, be honest; and base your response on the facts. Be ready to answer the question, Is it safe or is it dangerous? because that is what people really want to know.

You Can’t Educate Them All

Going into a presentation believing you are going to change everyone is unrealistic. No matter how hard you try to balance your point of view with those of others, there will be instances when even your best efforts fail.

The fact is, some people think pesticides are risky—or completely safe—and no amount of scientific argument will persuade them otherwise. Some people’s goals are best achieved by maintaining a controversy and by designating you, or the group you represent, as the opposition. Quite frankly, a risk communicator can easily become the enemy to both pro-pesticide and anti-pesticide groups!

The Delivery: Making an Audience Receptive to Your Message

You can help people become more comfortable in an uncomfortable situation by being approachable yourself. Begin your presentation by

communicating your interests: If you care about people's health, make that clear. If you care about good science and a safe food supply, make that clear. *Never* begin by focusing on an argument that needs to be settled.

Frequently, you will share more interests with your audience than either you or they realize; and finding common ground gets the speaker and the audience on the same side. If you truly care about your audience, make yourself available and responsive when they have questions. Matching your words with action is critical in earning their confidence.

Don't Just Tell Them What They Want to Hear

You can be a hero to your audience by telling them what they want to hear. It's simple: Tell pesticide users that pesticide issues have been blown out of proportion; and tell health and environmental advocates that pesticides are dangerous! But risk communicators who pander to the audience eventually lose their credibility.

Work Within Your Comfort Zone, But Learn From the Best

Capitalize on your skills and expertise by doing what comes naturally. Enhance your natural abilities by watching closely and incorporating positive aspects of others' speaking techniques that suit your style; but stay within your comfort zone at all times. Just as importantly, take note of any annoying characteristics in other speakers and consciously exclude them from your own delivery.

People Expect to Be Entertained

Learning is easier when you are having fun. And meaningful communication between you and your audience is most easily established when you enjoy speaking and can make them glad to be there. Education and entertainment often go hand-in-hand, and comedy is conducive to a good time for both speaker and audience; but don't make a joke of pesticide issues. Stay appreciative and respectful of people's fears and concerns, even when approaching your audience lightheartedly.

Stop Talking Before They Quit Listening

If you know that your audience views a situation as unfair, listen to and show empathy for their concerns. You might spend your visit with them most productively by setting up a context for listening. Be flexible. Don't get locked into the notion that you have to speak every minute of

your time frame. For example, limit your presentation to perhaps half the allotted time and spend the remainder listening to your audience and addressing their specific anxieties. Draw them into the subject. Listen to them. Carefully. Discuss their concerns candidly. They will remember who you are, and they will seek you out the next time they have concerns. You will depart with new friends, new contacts. And they will, too.

You've Got 20 Minutes to Set the Hook

The human brain works in cycles of attentiveness and inattentiveness, and the attention span of the learner generally is about 20 minutes. After 20 minutes, attention often is diverted elsewhere, and a period of inattentiveness may prevail for several minutes before the brain refocuses on the speaker. This cycle can repeat several times during a 60-minute presentation, but adding a twist to your delivery every 15 to 20 minutes helps rejuvenate your listeners.

State Your Purpose

Continually remind people what you are trying to accomplish and where you are in the program.

What Did You Say? I Can't Hear You!

Always use a microphone in a large room. It is important that everyone is able to hear your presentation without difficulty.

Connect the Dots to the Bigger Picture

Think of the issue in stages or steps, and present them in order—but don't be boring! Explain and demonstrate the logical steps in drawing valid conclusions. Impress upon the audience the basics of reasonable, accurate risk assessment; that is, replace the mystery component with knowledge and technique.

What I Know About Pesticides Comes from DDT and Agent Orange

Offer complete information on the benefits and risks of the pesticide being discussed. Most issues involve trade-offs, so present both ends of the spectrum and encourage discussion. Conclude by summarizing what has been addressed and offer your own slant, if appropriate; sometimes it is better left to the audience to form their own conclusions.

It's Show and Tell Time

A picture is worth a thousand words. This statement is true even when speaking about pesticide benefits and risks. Pictures and show-and-tell items facilitate the communication of concepts and key scientific principles much more effectively—and enjoyably—than mundane facts and figures.

It's Really Very Similar to . . .

People understand concepts better when they can relate to something familiar. Use examples or analogies that people can identify with in order to illustrate points or convey facts; but be very careful to avoid comparing risks that are not similar.

What Did You Say?

The language of science—abbreviations, acronyms, and jargon—is unfamiliar to most and difficult to teach, so don't go there! Use short sentences and familiar words to make understanding as easy as possible. Everyone prefers simplicity to complexity, summary to detail, certainty to uncertainty. Use common, everyday language and deliver your presentation as if you are talking to your own family and friends.

That Just Doesn't Make Sense

Government agencies such as EPA, state departments of agriculture, and state environmental divisions set safety standards that guide pesticide manufacturers and pesticide users; and public policy, science, and research help define and determine acceptable risk. But concepts often do not seem to make sense. People ask,

- How can eating pesticides on food be safe?
- What is the relevance of pesticide research on rats to human exposure?
- What do you mean that exposure does not necessarily imply harm?
- Do plants produce cancer-causing compounds?

These questions are best answered in perspective to the concepts of toxicity, exposure, risk assessment, and risk management.

That's Them. What About Me?

Science often addresses effects on populations, not individuals. But individuals are concerned about themselves and their families. They want to know if they personally will be affected.

That's Not What They Said

There often is conflicting evidence on an issue, which is inevitably brought up by someone in the audience. If you have done your homework, you are aware of the conflict and prepared to address it. Briefly state both points of view, then demonstrate your justification for the stance you have taken.

Key Points

Begin and end your talk by stating your key points. Plan your presentation around a few major points and, as you begin, tell the audience what they are. Communicate your take-home message and emphasize its importance. At the end of your presentation, ask the audience to restate your key points; if they leave some out, bill in the blanks as you conclude.

It Doesn't Have to Be My Way Every Time

Risks loom large when they are involuntary or even *feel* imposed. For instance, farmers are upset to learn that EPA may take a popular, inexpensive, effective pesticide off the market, thus increasing the cost of crop production. But explaining what farmers can do to keep the product on the market affords them an opportunity to impact EPA's final decision. People who do not want pesticides applied to or near their property have a right to influence the decision, as well.

Your job as a risk communicator is to inform your audience of their choices and the probable, corresponding consequences. If there are several solutions to a complex problem and each is technically equal, it is likely that the ultimate decision will reflect the values of the majority affected. And when people are thus allowed to exercise some control, they feel more confident in the decision.

No Way Do I Believe It's Not Risky

Confrontational remarks such as "There's no way that I believe it's not risky" bring everyone to the edge of their seats, awaiting your response. Ask the person who commented what it is that they don't believe, and respond with a calm, rational discussion. In many cases, it's simply best to say that it is all right to disagree, that you recognize and respect their position, and that you hope they can appreciate yours.

I've Never Been Hurt!

How can something be risky if it's never hurt me? Convincing people to change their behavior to avoid risk is difficult. Try telling stories that you have heard where someone, in fact, *has* been injured or hurt as a result of misuse of a pesticide product.

I Just Don't Care!

Some issues that you view worthy of discussion may not be important to some members of your audience. It might be that other problems are more pressing, that you didn't connect with them, or that they have taken a fatalistic approach: I can't control the risk anyway! This is their personal decision. Sometimes, all you can do is provide the information: it is up to the listener to decide if an issue is important to himself.

If Only I Could Do It Over

It is best to reflect on the program as soon as it is over. Ask yourself what you would change if you could do it over. Were there points that you had difficulty explaining? Were there questions you couldn't answer, or for which you felt your responses were inadequate? Did you learn something from the audience that you will be able to use in another program? What did you do well?

Make it a habit to write down key points and ideas immediately after your presentation; waiting even a short time fades your recollection. Incorporate changes so that you are continually improving your communication skills. As risk communication expert Peter Sandman has indicated, explaining risk information is difficult but not impossible—if the motivation is there.

The Role of the Internet

The ability of anyone, anywhere, to post their view on anything and everything—for the whole world to see—is the promise and the horror of the internet. Evidence supporting any *view* and any *thing* can be found on the net. Unfortunately, the *source* of information is not always clear and evident. In general, people treat information on the internet as factual; there is a general assumption that everything on the net comes from a reliable source, even when no source is listed. This raises the stakes—and opportunities—in the risk communication business.

Not only must we, as risk communicators, be up front and forthright with our one-on-one and group interactions, but as advocates of a balanced approach to truth we also must project our message on the internet. There is no reason why people seeking pesticide information

on the internet should be able to access only the positive or only the negative. We must jump on the internet bandwagon and post our message; and we must connect with every search engine available. We must STAND OUT and earn our own recognition.

Conclusion

Unquestionably, the use of pesticides has been and always will be controversial in our society. It involves very real and important trade-offs that concern people. Can one reasonably expect to educate the public amid so much background noise? And what about all the complications surrounding pesticide risk? Well, sometimes it is the noise that creates the *interest . . .* and people listen!

Is it possible to educate the public on pesticide risk when the issues are couched as *good news versus bad,* or *them versus us?* Do people have the patience—or the interest—to listen to more of the facts? Will they tolerate descriptions of risk/benefit trade-offs instead of the either/or scenarios of advocates? Do people have the ability to understand science-based, reasoned explanation of the need for pesticides and the consequences of use, both good and bad? Will they listen with an open mind before making their own decisions? The answer is yes. The public will listen to a credible communicator who earns their respect; and the backbone of respect is knowledge and effective communication.

Interest in risk communication is at an all-time high as government officials, industry representatives, scientists, and health and environmental safety advocates strive to communicate why the public should or should not worry about pesticide risk. Delivery of a clear and effective message through teaching, conversation, writing, or speech is a difficult proposition, even in the best of situations.

It is difficult to get people to understand and accept risk. It is also difficult to get those who ignore risk to acknowledge and respect it. As individuals, we base our beliefs on what we know; and what we know depends largely on our source of information. A person's knowledge on pesticides, coupled with their own personal values, forms the basis for their stance on the issue.

There are myriad views on pesticide risk. But people tend to key into concepts that complement their own agenda, that is, concepts that validate their own preconceptions.

As risk communicators, our success in *educating* the public hinges largely on our skills in *public relations.* Instead of talking *to* an audience, we need to talk *with* them, to engage them in healthy dialogue. We must acknowledge and respect the audience's point of view, even if it is unfounded or inappropriately skewed. We must afford the audience an opportunity to validate their concerns; and we must share our points of view and identify areas of agreement.

Technical information alone will not address public concerns effectively, nor will it necessarily reduce regulatory restrictions. The key is interaction and dialogue.

We must stay abreast of scientific developments and changes in pesticide policy if we are to achieve effective risk communication, and we must understand our audience. We must present concepts that are clear, understandable, and nonthreatening. We must embrace questions and treat discussions, responses, and what may seem to be unreasonable concerns (or lack of concern) with equity.

Skillful risk communication techniques and useful examples that audiences can relate to are paramount to our dissemination of understandable, useful, pesticide information. Our goal is to reduce unreasonable fears, heighten awareness, foster support, and steer good public policy.

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