



Integrated Pest Management Literacy Plan

For K-12 Education



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Northeastern School Integrated Pest Management Working Group

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Executive Summary

This Literacy Plan was developed by the Northeastern School Integrated Pest Management Working Group (NESIWG) in collaboration with educators from across the 12 northeastern states. The purpose of this plan is to identify needs and opportunities for improving awareness and understanding of integrated pest management (IPM) -- best practices for protecting people, our food supply and our environment from pests, using science-based methods that minimize reliance on pesticides. This plan is intended as a road map for use by K-12 educators, pest management specialists, and others to identify pathways for collaboration and partnership, strengthen the availability and utility of educational resources, and ultimately, promote increased human and environmental health and a stable food and fiber supply. We recommend establishment of local, state, and/or regional IPM literacy task forces to lead efforts to promote and coordinate these IPM educational objectives:

- 1) Identify and evaluate existing IPM educational resources,
- 2) Develop new resources for IPM education and make resources widely available to educators,
- 3) Strengthen local, state, and regional networking and partnership opportunities to support IPM education,
- 4) Incorporate IPM learning goals into all education standards in each state,
- 5) Promote IPM curricula as a means of addressing mandatory curriculum requirements,
- 6) Encourage and support inclusion of IPM education in teacher training programs.



Introduction

What is Integrated Pest Management?

Undoubtedly, the first question for most people is ‘What is Integrated Pest Management?’ Integrated Pest Management (IPM) is an approach to managing properties such as farms, forests, homes and schools, to protect ourselves and our resources from pests.. IPM emphasizes the use of biological, physical, and cultural methods to prevent and manage pest problems while minimizing risks posed by pests and pesticides. This approach has been used very successfully, for over 30 years, first by farmers and more recently by pest managers in every setting, to protect people, our food and fiber supply, and the environment from the potentially harmful impacts of pests and pesticides. Yet, most people have never even heard of IPM!

Before the widespread availability of chemical pesticides, people used cultural practices and common sense to manage pests around the home and on the farm. In recent years, however, homeowners increasingly turn to widely and readily available chemical pesticides. Advertisers promote pesticides as a ‘silver bullet’ for everything from ticks, mosquitoes, and weeds to ants and bathroom mold. According to the US Environmental Protection Agency, 100 million pounds of pesticide active ingredients were applied in homes and gardens in the United States in 2001. Of that, homeowners used 13 percent of the total amount of herbicides used in the U.S., 16 percent of total insecticides and miticides, and 16 percent of total fungicides.¹ This increased reliance on pesticides is not without risk. The instructions for product use are often printed in very small type and the precautionary language can be difficult to interpret. The potential for misuse is high. In fact, statistics show alarming rates of pesticide poisonings in the U.S. In 2005, over 93,000 people reported unintentional exposure to pesticides --excluding disinfectants. Twenty percent of these required treatment in health care facilities and more than 20,000 cases showed clear signs of poisoning.² Education is needed to address and reduce over-reliance on, and misuse of pesticides.

With IPM the goal is to protect the resources (people, our communities, and our food and fiber crops) while minimizing harmful impacts. This requires taking a holistic view to know when and what kind of pest management intervention is needed to tip the balance of nature in our favor. Effective use of IPM requires that we learn a bit about why nature sometimes becomes a pest. For instance, when is a plant considered a weed? Why do carpenter ants play an

important role in maintaining forests, but are feared pests in our homes? Armed with a basic understanding of pest biology and ecology we can keep pests from causing us harm without disrupting the natural environment. When we learn the conditions leading to pest problems, we can often eliminate pests simply by changing those conditions.

The need for improving competence in the scientific fields in the U.S. has been well recognized.³ Science, technology, engineering, and math (STEM) initiatives at the national, state, and local levels have been undertaken to increase science literacy and prepare students for careers in those fields.⁴ At the same time, environmental literacy has been identified as a critical need to reconnect people with nature.^{5,6} IPM education addresses all of these needs by providing relevant and practical application of biology, ecology, and math and offers opportunities for engaging learners through practical problem solving. IPM methods are biological (such as the use of beneficial organisms to control pests), physical (for example, the use of heat to kill bed bugs), cultural (e.g. altering crop-planting times to avoid pests or sanitation to control filth flies), regulatory (e.g. laws prohibiting transport of pests), genetic (e.g. breeding disease-resistant plants), social (eg, education to encourage pest avoidance behaviors such as not sharing combs and hats to avoid head lice) or chemical (e.g. use of pesticides and repellents). Therefore, elements of physical and biological sciences, health, math, language arts, and even public policy, can easily be woven into IPM education.

Is it just farmers and foresters who need to learn about IPM? No! We all make pest management decisions every day in our actions and our purchases of products and services. Questions such as ‘Do I need to hire an exterminator or is that just a harmless bug in the house?’ and ‘What kind of repellent is best for mosquitoes and ticks?’ and ‘What’s the best way to keep our lake-front lawn green while protecting the environment?’ can only be answered with a basic understanding of the ecological and biological processes involved. To protect people and our food and fiber supply from pests while safeguarding the planet against environmental harm the next generation needs to be IPM literate.

What is IPM Literacy?

- Understanding what the term ‘pest’ means. Understanding that no living organism is inherently a pest, rather, the concept of ‘pest’ is human-defined. Understanding that

people call a living organism a ‘pest’ when and where its population density threatens our health and comfort or food and fiber supply.

- Understanding the ecological roles of ‘pests’ in the natural world; for example, how pests interact with other organisms and the environment.
- A basic understanding of the social, biological, ecological, and physical processes that can lead to pest ‘problems’.
- Knowledge that people can utilize cultural, physical, mechanical, biological and regulatory means, sometimes accompanied by selective use of chemicals when needed, to keep pest populations below harmful levels.

Why Teach Integrated Pest Management to K-12 Students?

- IPM education provides practical examples demonstrating basic science, math, and engineering concepts
- IPM education is an excellent way to engage and connect K-12 students to the natural world.
- IPM provides relevant examples demonstrating impacts of human activity on the environment.
- Traditional, pesticide-based pest control approaches threaten human health and cause environmental disruption. The next generation of earth’s citizens must be informed about sustainable, least-risk pest management practices to protect our food and fiber supply, safeguard the environment, and promote human health.
- People are directly confronted with pests regularly and must make informed decisions to protect themselves from pathogens, biting insects, poisonous plants, and sometimes even vertebrates such as rodents.
- IPM education provides practical knowledge that students and teachers can use in school gardens, greenhouses, agricultural/horticultural programs, vocational/technical education programs, and in their own homes.

How Should IPM be Included in K-12 Curricula?

We recommend that basic IPM concepts be introduced as part of science, math, language arts and social studies in elementary grades, with more advanced concepts and applications being integrated with the same disciplines in high school. In addition, IPM education fits very well with agricultural and environmental education. IPM methods should be essential learning objectives in school garden projects, school greenhouses, and career/technical agricultural programs.

A graduated approach to integrated pest management education should follow a logical progression from awareness about pests and IPM in lower grades to knowledge that can be applied to real pest management situations in higher grades. A framework for introducing IPM concepts integrated with environmental science and ecology, borrowed from Pennsylvania's academic standards is shown in Appendix A.

Connecting Integrated Pest Management to Environmental and Agricultural Literacy:

Environmental and agricultural literacy is crucial for the next generation to succeed in creating a sustainable society. IPM is part of environmental and agricultural literacy. IPM lessons provide excellent learning opportunities about human interaction with the environment and illustrate the importance of responsible stewardship.

This document identifies opportunities for collaboration with environmental and agricultural literacy initiatives and established programs to share resources, build on successes, and meet a unified common goal of improving environmental, agricultural, and IPM literacy.

Examples of Scientific Concepts/Topics which can be Included in IPM Curricula:

- Animal and plant reproduction
- Biological diversity
- Carbon cycle and water cycle
- Chemistry, biochemistry, and physics
- Classification of living organisms
- Community ecology
- Ecological food webs and nutrient cycling
- Invasive species
- Life cycles of plants and animals
- Microbiology and cellular biology
- Photosynthesis
- Pollution prevention
- Population ecology
- Predator/prey relationships
- Sustainability

Strategic Plan

Goals

- 1) Increase understanding about IPM among students and educators in the Northeast.
- 2) Empower all citizens to make informed decisions to protect themselves and our planet's resources from pests while minimizing risks of pesticide exposure.
- 3) Promote and support collaboration among environmental, agricultural, science, and IPM education programs to support common goals and maximize effectiveness.

Objectives

- 1) Identify and evaluate existing IPM educational resources,
- 2) Develop new resources for IPM education and make resources widely available to educators,
- 3) Strengthen local, state, and regional networking and partnership opportunities to support IPM education,
- 4) Incorporate IPM learning goals into all education standards in each state,
- 5) Promote IPM curricula as a means of addressing mandatory curriculum requirements,
- 6) Encourage and support inclusion of IPM education in teacher training programs,
- 7) Identify potential funding sources to support IPM education.

Establish Northeast Regional IPM Literacy Task Force. We recommend that an IPM literacy task force be established, recruiting key representatives from across the northeast, to identify opportunities to initiate, promote, and support improved K-12 IPM education throughout the region. Task force members could be recruited from state departments of education, conservation and agriculture, Agriculture in the Classroom, 4-H and FFA programs, environmental education organizations, science education organizations, colleges and universities, Cooperative Extension programs, and others involved in K-12 agricultural, environmental, and science education. The task force should develop a road map for improving K-12 IPM education at the regional, state and local levels.

Regional Task Force Actions

- Develop standards and evaluation criteria for IPM education for each grade K-12.

- Develop standards and evaluation criteria for the high school career/technical level.
- Identify needs and opportunities for incorporating IPM education into K-12 classrooms and other formal and informal education settings.
- Develop a ‘road-map’ or strategic plan, identifying stakeholders, partnerships and specific action steps needed to initiate, promote and support improved K-12 IPM education.
- Develop strategies for teacher training. Recruit topic experts and educators to offer teacher workshops, webinars or other educational media for training teachers. Identify new and current opportunities for educating teachers such as workshops at conferences, professional development programs, undergraduate and graduate education classes, summer institutes, on-line training, self-paced modules and more.
- Evaluate, compile and distribute existing curricula, resources, and materials for classroom IPM education. A list of potential resources can be found at the end of this plan.
- Identify needs for the development of new curricula and other teaching resources.
- Maintain a web-based compilation of IPM resources and materials and promote its availability to educators. This web-based collection should include curricula, individual lesson plans, information about IPM, strategies for IPM integration in the classroom, and contact information for experts in the field. It can also include related environmental and agricultural resources.
- Explore needs and opportunities for including IPM concepts in national, regional, and state academic standards.
- Explore opportunities for partnership with related education programs such as environmental education, agricultural education, farm-to-school lunch programs, school nutrition education programs, wellness education, school gardening programs and more.

Recommended Actions for Post-Secondary Teacher Training Programs

- Incorporate IPM education into pre-service teacher education. Institutions of higher education in the northeast should take action by including instruction to pre-service teachers in IPM teaching methods. This instruction could be included in elementary,

middle or high school education science methods classes or in agricultural/technical methods courses.

- Incorporate more IPM education into biology, environmental science, agriculture, and other undergraduate and graduate programs.
- IPM educators in Cooperative Extension programs at land-grant universities are a good resource to assist in developing learning objectives, syllabi, and curricula, identifying appropriate text books, equipment, and other resources, or giving guest lectures.

Recommended Actions at the State and Local Level

- Identify teachers with IPM education experience to provide support for new K-12 classroom IPM educators.
- Identify on-going educational programs and events where IPM education is or can be offered. Advertise and promote these events to teachers, school administrators, curriculum coordinators and similar audiences.
- Identify IPM educators to offer workshops on IPM education for teacher accreditation. School districts should contact cooperative extension offices in their area to find candidates to teach workshops on IPM education to their district teachers. By offering accredited workshops, teachers have incentive to learn the content of IPM and strategies for incorporating it into the classroom.
- Investigate the current curriculum plan to see where IPM could be integrated. The district can ask the curriculum coordinator or a group of interested teachers to look at the school curriculum and determine places, especially in the math and science curriculum, where IPM instruction can be added.
- Connect teachers with school facilities management to develop service learning, project-based learning, or other hands-on opportunities for students to participate in IPM activities. Service learning projects could include inspecting school buildings for pests or pest-conducive conditions, pulling weeds, putting out safe pest traps, installing pest-proof barriers such as floating row cover, bird-netting or fencing.
- Educate school health and wellness advocates on IPM and its benefits for schools and communities. IPM has been shown to reduce asthma triggers and improve indoor environment quality. Pest related health issues such as those associated with bed bugs,

cockroaches, rodents and biting arthropods can be addressed through IPM education. In addition, wellness programs can offer a source of funding for IPM educational projects.

- Partner with environmental education programs, centers and organizations to incorporate IPM education into youth environmental education programs and teacher workshops.
- Partner with teacher organizations like the National Science Teachers Association, the National Education Association, and other national, state and local teacher organizations to explore opportunities for outreach, teacher training, curricula development to promote IPM education.

Some Examples of Potential Partners to Promote and Support IPM Education

- Federal agencies such as US Department of Education, US Department of Agriculture, US Centers for Disease Control, US Fisheries and Wildlife, US Environmental Protection Agency
- Northeastern IPM Center and other regional IPM Centers
- Environmental advocacy, protection and research programs such as Audubon, Gulf of Maine Research Institute, Natural Resources Defense Council, Natural Resources Council of Maine and many other similar organizations
- Land-grant universities
- Cooperative Extension programs including IPM Programs, Master Gardeners, and 4-H
- State agencies including departments of agriculture, education, environmental protection and health
- Education associations such as associations of science, agriculture, and environmental educators
- National and state Agriculture in the Classroom programs
- Local or state-wide STEM (science, technology, engineering, math) education programs
- Land trust organizations
- Independent environmental, science, and natural history education centers and programs

Expected Outcomes

K-12 students will be provided with IPM education starting in elementary school and continuing through secondary school. IPM literacy rates will improve. Subsequent generations of Earth's stewards will be knowledgeable in IPM methods that protect people and resources from pests while minimizing harmful effects of both pests and pesticides.



Academic Standards

- Key IPM topics will be outlined for suggested use in K-12 curriculum on a grade by grade basis. Examples can include Pennsylvania Ecology and Environmental Educational Standards for K-12 students and alignments of University of Connecticut's IPM Curricula with state and regional standards (see [Appendix A](#)).
- IPM curriculum available in the public domain will be aligned with current federal and regional science and environmental standards, so that these resources are more user-friendly for teachers to adopt. By aligning IPM curricula to academic standards, teachers can easily see where IPM education can fit into their schedules, thus making it easier to integrate IPM education into their classroom.

Professional Development

- By offering IPM education in the elementary and secondary schools there is a basis for interest in IPM-related professional fields. Trade skills for these fields should then be integrated into technical schools and certificate programs to promote student pursuit of jobs in landscaping, horticulture, arboriculture, agricultural, research etc.

Assessment

- Through the actions outlined in this plan there will be quantifiable student and teacher learning. The impacts of integrated pest management education in K-12 schools will be monitored to evaluate the program's success as IPM awareness and knowledge diffuse throughout the northeast. To evaluate the success of the program we will monitor the

number of trained education specialists and teachers who participate in IPM education workshops. State departments of education can also help track the number of schools providing IPM education to K-12 students. The full means for assessment of the program are outlined in the Logic Model in Appendix B.

Conclusions

This literacy plan was developed by the Northeast School IPM Working Group to identify needs and opportunities for improving IPM education and achieving IPM literacy in the Northeastern region of the U.S. Literacy in Integrated Pest Management means understanding the role of ‘pests’ in the natural world and how our actions against these ‘pests’ directly affects human health and the environment around us. These concepts need to be taught to K-12 students so that they can make informed decisions about how to handle ‘pests’ in their surroundings and the ways in which these actions will affect their health and the environment. IPM education will promote concepts of biology and ecology and can be fit into already established curriculum plans. IPM literacy can be achieved through taking action to promote the education of IPM in elementary and secondary schools.

The goals of this literacy plan are to identify needs and opportunities for improving understanding of IPM principles and practices among the general public, beginning in K-12 classrooms and other youth education programs. We recommend the establishment of a regional task force to provide guidance and leadership for an increased effort to provide IPM education in our regions schools, environmental education centers and other youth education programs. The task force should engage in the identification and evaluation of IPM resources, the development of new resources, the networking of IPM partnerships, the promotion of IPM in academic standards, and the inclusion of IPM in teacher training programs. This task force will also encourage state education agencies, institutions of higher education, K-12 school districts, environmental education organizations, teacher organizations, and individual educators to take appropriate action to include IPM education into the everyday lives of students and educators.

The intended outcomes of this action plan are that IPM will become a household word, understood and utilized by citizens everywhere to minimize risks of exposure to pests and pesticides. IPM will be incorporated into academic standards and in school curricula and

students will be encouraged to pursue professional fields related to IPM. Assessments will be conducted to provide quantifiable student and teacher learning and insight into the effects of teaching IPM literacy. Literacy in integrated pest management, coupled with environmental and agricultural literacy are key components of educating today's generation on what it means to be sustainable. By raising awareness, we hope to change attitudes and behaviors of tomorrow's decision makers. Integrated Pest Management is a part of the broader sustainability movement, and these concepts will help them become better stewards of our planet's resources.

Resources

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Appendix A

Standards

* Borrowed and adapted from Pennsylvania Environment and Ecology Academic Standards

Elementary School:

Kindergarten / Grade 1	Grade 2/ Grade 3	Grade 4 / Grade 5
Identify living and non living things	Life Cycles, food chains. Basic insect identification	Ecosystem dynamics and illustrate that all organisms depend on living and nonliving features in their environment for survival
Differentiate animals from plants etc.	Differentiate between organisms that humans may classify as pests and/ or beneficial and why they are situation dependent	Introduce integrated pest management and describe common IPM techniques used at the school
Discuss pros and cons of pesticide use	Common household IPM practices to deal with pests (i.e. weeding, cleaning spills etc)	Discuss agricultural systems and how IPM is use to grow crops common to your region

Middle School and High School:

Grade 6/7	Grade 8/9	Grade 10/11	Grade 12
Discuss how human actions can effect an ecosystem and how it can be detrimental to an environment	Explain how pest control can effect humans and the environment	Research and analyze the long-term effects of pest management practices on the environment	Research and design an effective IPM plan for a non-agricultural or agricultural situation, and describe mechanical, biological or chemical methods used
Discuss historical events that have influenced pest management (such as DDT use) and go over short and long term effect	Identify risks associated with pest management practices on terrestrial and aquatic ecosystems	Analyze the risks and benefits to the environment and society associated with alternative practices used in integrated pest management	Research and analyze pest management practices globally

Appendix B

Logic Model

Participants: Northeastern School IPM working group, state and regional governments, private and non-profit organizations tied to IPM

Goal: Integrated Pest Management education in K-12 schools to promote IPM literacy in the northeastern region

Target audience: K-12 schools

Inputs	Outputs	Outcomes		
<ul style="list-style-type: none"> Land grant universities & extension State and federal regulatory agencies Advocacy groups & other NGO's (including related environmental & agricultural organizations) Pest management industry School teachers Teacher organizations Leveraged funds 	<p style="text-align: center;">Audience</p> <ul style="list-style-type: none"> Teachers & Education Specialists Departments of education Environmental & agricultural education/ advocacy groups State & federal regulatory agencies <p style="text-align: center;">Activities</p> <ul style="list-style-type: none"> Collaboration among input groups to pool resources and diffuse IPM awareness (especially environmental and agricultural organizations) Provide IPM education for K-12 teachers Compile database of resources for IPM education Make available IPM resources user-friendly (align to academic standards) Encourage IPM education to be included in regional academic standards 	<p style="text-align: center;">Short Term</p> <ul style="list-style-type: none"> Diffusion of IPM awareness in K-12 teachers Increased number of K-12 students that are exposed to IPM education Collaboration between environmental and agricultural groups that cross promote sustainable practices <p style="text-align: center;">Possible Measurements</p> <ul style="list-style-type: none"> Number of teacher's that participate in IPM education workshops Monitor the number of schools that offer IPM education (work w/ Departments of Education) Work with environmental and agricultural advocacy groups to estimate number of children exposed to IPM through non-classroom settings 	<p style="text-align: center;">Intermediate</p> <ul style="list-style-type: none"> Attitude changes in students and teachers in sustainability Increased IPM knowledge & skills among high school graduates <p style="text-align: center;">Possible Measurements</p> <ul style="list-style-type: none"> School environments that engage in IPM activities; i.e., school gardens, reduced pesticide use etc. Number of high school students that graduate who have participated in IPM education or have gained trade skills related to IPM 	<p style="text-align: center;">Long Term</p> <ul style="list-style-type: none"> Improved integrated pest management literacy in citizens in the northeast region to make decisions concerning personal and community- wide activities to promote sustainability <p style="text-align: center;">Possible Measurements</p> <ul style="list-style-type: none"> Increased sustainability within Northeastern communities by engaging in IPM practices <ul style="list-style-type: none"> reduced use of pesticides transition to less toxic pesticides increased cultural, physical & biological controls Transition to landscapes and crops that are native to area that require less maintenance

Appendix B (con't.)

Logic Model

Participants: Northeastern School IPM working group, state and regional governments, private and non-profit organizations tied to IPM

Goal: Integrated Pest Management education in K-12 schools to promote IPM literacy in the northeastern region

Target audience: K-12 schools

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