AN EDUCATIONAL ASSIST TO URBAN PEST MANAGEMENT

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INTRODUCTION

For the past several years urban research and extension specialists have attempted to answer the problems associated with urban pests and convince homeowners, apartment dwellers, and business people to implement appropriate solutions. As has been the case with agricultural pest management, the success in these endeavors has been less than desired. I've concluded from my 25 years of research, extension, and teaching activities that a different approach must be made in dealing with those one wishes would implement pest management. While a conclusion not universally accepted, many of us at Purdue University try to teach students and practitioners that integrated pest management (IPM) is a philosophy and not a technology. It is acceptance of a belief, a set of principles, a set of guidelines by means of which one then implements certain technological applications. Inasmuch as a person's philosophy is often as inviolable as one's religion, we have struggled without a great deal of success to secure adoption of appropriate pest management by the adults with whom we deal. Technology is easy! One can try a new technique on a limited area or for a limited amount of time and assess the results. One cannot, or at least, does not, try a little of a new philosophy.

Many of us here at Purdue and other universities believe that we must implement new educational approaches if IPM is to be adopted significantly in the urban and rural communities. Consumer attitudes must be changed. As most of us know, one seldom achieves satisfaction in attempting to change another adult's view of religion or other strongly held personal beliefs. It is, however, relatively simple to work with children in such a way as to lead them to personal adoption of appropriate philosophy and moral code. In a similar fashion, more and more educators have become convinced that IPM will only become comprehensively adopted if we begin offering such beliefs to children early in their educational programs. To this end, many programs of youth education have been on-going for a number of years. We must also enhance the science exposure in our elementary grades if our young people are to approach problems with a critical eye. We must teach our children to approach problem solving as a process, not as an objective.

Furthermore, our elementary school age children need this biological education. It is reported that 10-year-old children in the U.S. are about average in their science achievement with their international peers . By the time these children reach the age of 14 years, they rank 14th when compared with children from 17 countries (Moore 1990). Furthermore, states Cowley *et al.* (1990) "by the third grade only 50% of all students want to take more science courses. By the time they reach 8th grade, only 1 in 5 students wants to take more science." Is it because only 1% of our elementary students receive more than 2 hours of "hands-on" science per week (Moore 1990)? Why don't our teachers take advantage of this early curiosity which is so important in learning (Koran and Longino, 1982)? Do our elementary grade teachers talk about science instead of "doing" science? Is all this the fault of our elementary teachers? When elementary school teachers in Dade County, Florida were asked their most important goal for their students, only 8.5% responded that it was to instill "a continuing desire for knowledge, an inquiring mind." And only 1.2% stated that "the habit of weighing facts and imaginatively applying them to the solution of problems" was their most important goal (Kottkamp et al. 1986). Nearly half (42%) believed that teaching the "basic tools for acquiring and communicating knowledge—the Three R's" was their most important goal.

Many blame our colleges and universities and their programs for teacher education, particularly the undergraduate programs in science education (Moore 1990). Many others blame the secondary

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emphasis placed on university teaching when compared with university research. As Moore (1990) so aptly states, "Brilliant teaching won't save an assistant professor if he or she has done no research. However, mediocre research will usually be enough for someone to obtain tenure, regardless of their teaching abilities."

METHODS AND MATERIALS

To be truly effective in this learning endeavor one must reach children with appropriate messages not just once or twice during their childhood but on a repetitive basis. Both time and money constraints limit specialist visits to classrooms. Furthermore, lack of follow-up activities result in material presented by an IPM specialist being quickly forgotten by students. A few years ago I decided that to be effective and efficient in educating students of the principles and guidelines of IPM, programs must be developed which can be conducted by classroom teachers. To this end I developed and have taught for two years a class for students at Purdue University who aspire to teach in the elementary (Kindergarten through grade 6, ages approximately 5 years through 12 years) classroom. It is my contention that several things about students in the elementary grades make them ideal subjects for entomology and IPM education.

Students in urban environments have significantly reduced biological experiences from those in rural communities. They have less knowledge of, and consequently greater aversion to, insects and their effects. Furthermore, a reduced emphasis on science education in the 1970's and 80's has reduced the ability of teachers now in the classroom to effectively contribute to biological education of students. Teachers present what they have been exposed to and are comfortable with; what they learned, and feel will effectively stimulate their students to learn. A teacher with an aversion to "bugs" is unlikely to either teach about insects or effectively use insects in the elementary classroom. However, a knowledgeable teacher who has been exposed to entomology and IPM will use the natural curiosity of students toward living things in general and insects in particular to capture the interest of students for extended periods of learning. Bruner (1966) stressed that we must involve more "intrinsic motivation" in the teaching-learning process. And Bruner went on to profess that intrinsic motivation begins in early childhood with curiosity characterized by a shifting of attention related to change and vividness. The challenge to educators is to encourage students to master their curiosity and act upon it (Cohn and Kottkamp, 1993). My objectives were to create a course such that teachers in training would be given sufficient knowledge about insects to effectively appeal to the curiosity of children and enhance the learning process.

In teaching my course "Insects in Elementary Education" I am striving to provide sufficient knowledge and motivation for future teachers to enable them to provide a better education for children. I have several specific objectives which fall into two general categories: providing biological information about insects and related arthropods which is of value to children (and adults); and using these organisms to convey concepts and ideas important in the general education of students.

- First I am trying to introduce teachers, and thereby students, to some common urban pests: their identification, biology, behavior, and management. I use a limited number of organisms throughout the course so that teachers become familiar with them. Some of the organisms we use in the class are isopods, centipedes, millipedes, cockroaches, ants, termites, flour beetles, Indian meal moth, yellow mealworm, fruit flies, house flies, blow flies, crickets, and milkweed bugs.
- I stress the value of keeping colonies of these organisms in the classroom so that they are available when needed. I stress the value of these organism being available for student observation, and the value of students being involved in maintaining such colonies, and thereby becoming familiar with the common attributes of such organisms individually and collectively. By doing so students learn what these organisms eat, how much they eat, what other life sustaining requirements are, what the various life stages look like, particular behavioral activities, and the responsibility of caring for living things. I require my students in the class to raise several of these insect for a matter of weeks to show them just how easy it is. These include red flour beetle, yellow mealworm, tobacco hornworm, milkweed bug, fruit flies, praying mantids, cockroaches, crickets, and termites. I provide rearing information for each, particularly

where complicated procedures might otherwise be difficult or confusing, e.g. fruit fly diets (Table 1.) and termite rearing. After rearing these insects for a matter of weeks most of the students feel comfortable with the idea of doing so in the future when they have their own classroom.

Table 1. York's Famous Microwave Fruit Fly Diet

This recipe will make about 5 flasks of about 50 ml (2 oz) each. You will need a container to mix in. Preferably it will hold about 3-4 cups. A quart canning jar or a 1000-ml flask works very well. Also a 3 or 4-cup measuring cup works well

Ingredients:

Water	250 milliliters (a little more than a cup)		
Agar	3 grams	=	1 tsp.
Sugar	13 grams	=	1 Tbs.
Yeast	7 grams	=	1 pkg.
Cornmeal	19 grams	=	2 Tbs.

Procedure:

1. Mix agar in 150 ml (5 oz) water (in a container which will hold at least 50-100% more than the final total mixture [1000 ml or 2-3 cups] or it will boil over) and bring to boil in microwave. Depending on microwave will require about 1-3 minutes (full power). Stir or swirl mixture occasionally while heating.
2. Mix rest of ingredients into agar, (don't forget yeast) add remainder of water (100 ml or 3+ oz) and mix well.
3. Bring total mixture to a boil, ca. 1-2 minutes; while heating, stop and stir mixture occasionally. At this point watch to see that it doesn't boil over.
4. Add 4 ml (1 tsp.) of preservative and stir or swirl it around to mix.
This preservative is made by mixing 10 grams of methyl paraben (Brand names = Tegosept, Nipagin, methyl parsept) in 100 ml of 95% ethyl alcohol (Everclear at liquor store).
5. Carefully pour about 50 ml (2 ounces) into rearing containers and allow to cool.
6. When it has cooled and hardened, flies may be put in. Store extra containers under refrigeration to prevent deterioration.

- I provide my students with activities which will stimulate the interest of students in living organisms, science, and the scientific process. Bodner (in press) expresses very well the value of using discrepant events in learning the following skills necessary to all students:

  - Observation: identify characteristics perceivable with the senses
  - Measurement: quantities such as mass, extent, or degree in standard units
  - Classification: place objects, ideas, or events into groups or categories on the basis of similar characteristics
  - Inference: make inferences about objects or events not observed on the basis of those previously experienced
  - Prediction: make reasonable predictions about future events based on knowledge from previous events
  - Communication: express ideas orally and in writing

  The behavior of arthropods offers an almost unlimited number of activities (often presentable as discrepant events) under various natural or artificial conditions. For example, we examine termite trailing behavior presented as termites who can read written signs; cockroach and isopod choice of light or dark, wet or dry, warm or cold. We study the response of hungry and thirsty cockroaches to presence of food and water, and their choice of foods. Grooming behavior is studied in cockroaches, flies, and praying mantids. We look at the feeding behavior of houseflies and their ability to discriminate concentrations in sugar and artificially sweetened solutions. As students conduct these activities I urge them to keep in mind eight questions posed by Hamilton *et al.* (1990):

What do you see?
What is it like?
Why do you suppose?
What do you think?
What might happen if?
How can we find out?

Can you think of another way?
What would you do if?

- Throughout the course I introduce organisms as models for studying broader concepts and principles. We use fruit flies and red flour beetle to study population growth and the effect of limited resources thereon. Ecological roles are examined using primary consumers, secondary consumers, and decomposers (termites and cockroaches). We use several of the organisms to study the concept of speed relative to size. The general area of communications and the specific role of pheromones therein is easily addressed. Of particular value for this are honey bees, flour beetles, Indian meal moth, and termites.
- Finally, I attempt to introduce some practical pest management. My students have already learned that many of those organisms which they considered "pests" prior to entering my class are indeed beneficial to the learning process. By the nature of the class they have learned and are ready to pass on that the term "pest" is a sociological label, not a biological phenomena. We examine insect control strategies. Using praying mantids and stink bugs we effectively convey the concepts of biological control of "pests." At the same time, using praying mantids, and milkweed bugs fed on milkweed seeds as opposed to those having fed on sunflower seeds, we can demonstrate the concept of protection provided by food plants, mimicry, and learning by predators. Using plants such as chrysanthemum, lemon, and tobacco we look at naturally occurring insecticides. We study pheromones as monitoring devices and in conjunction with sticky traps as management tools. We experiment with and discuss the failure of electronic "repellers" for cockroach management.

My greatest problem is what to include in the limited amount of time I have with the students. We meet for a 2-hour period once a week for 16 weeks. We have no exams, but each student is required to keep a journal documenting his or her awareness of insects and arthropods as they appear in the press, etc. Also each student is required to prepare some kind of project or activity appropriate to the student age they wish to teach. Each student is also required to prepare a bulletin board on some arthropod/insect-related topic.

I begin each class period by giving students an opportunity to share what ways they have used insects in a classroom in the previous week. As our students are involved in significant "in-study" classroom time, nearly all have things they wish to share with the class. These range from brief (2 to 3-day) experiences in science teaching to extended periods of tutoring reading. For the latter, I have assembled an extensive collection of children's books on insects and other arthropods. After this I give a brief introduction to that period's topic(s). Thereafter I have my students conduct the experiments or activities as though they were the elementary grade students. For most of the activities, I provide a study guide appropriate for elementary grade children. I also provide a Teacher's Guide for each activity, but do not give this to the students until they have completed an activity. By requiring my students to carry out an activity, they become familiar with the discrepant nature of many of the activities, and excitement and pitfalls which may occur. I have received significant beneficial feedback from the students as to what is good and bad about particular activities. We can usually complete 2 or 3 activities in a 2-hour period. There is significant difference as to the sequential order of the class as it is taught in the Fall term (late August to early December) as opposed to the Spring term (January to early May). In the Fall we can begin the class by going outside to observe habitats and collecting specimens for identification activities and later rearing. In the Spring term, we must begin with indoor activities and hope that good weather will occur on class days to permit outside activities in mid to late April. This is a generalization, however, as each time I teach the class, it differs considerably.

RESULTS

The class has been a success. While I can handle effectively only about 10 students per term because of the intensity of the "hands-on" activities, this may change. This term an undergraduate student I had in class last term asked if she could assist me in teaching the class. She said that she had gotten so much value from the class that she wanted to do it again, and from a different perspective.

Table 2. Schedule and topics of the Fall term of Entomology 307G: Insects in Elementary Education

28 August	Class Introduction. Requirements. Tour of Entomology facilities.
4 September	Field trip: collecting insects. Insect Scavenger Hunt (1 hr). Sorting and classifying what we've collected. Take home a hornworm to raise.
11 September	Trip to the apiary. Open a beehive. Bee behavior. Take home a Madagascan cockroach to raise.
18 September	Insect Identification. Activities: Insect exoskeleton and metamorphosis. Insect eyes, wings, legs, wings. Take home mealworm beetles to raise.
25 September	Insect Identification. Activities: Insect mouth parts and feeding behavior: box elder bugs, hornworms, mantids, moths, and flies. Take home a praying mantis to raise. Begin population/food resource experiment with wingless fruit flies.
2 October	Feeding behavior. Stink bugs as predators. Flies taste with their feet. Microwave fruit fly diet. Take home a colony of fruit flies to raise. Start flour beetle/cereal population study.
9 October	Finish and discuss fruit fly population study. Some great videos showing insect feeding behavior. Baka tribe and honey. Honey tasting. Study the honeybee observation hive some more. Insect cookies.
16 October	Learning by insects. Mimicry: praying mantids and milkweed bugs. Teaching termites to read. Evaluate fruit fly population study results. Take home baby milkweed bugs to raise. Count red flour beetles.
23 October	Insect mathematics: mealworms and mazes. Isopod and cockroach choices. Take home houseflies to raise. Count flour beetles.
30 October	Insect grooming: flies, cockroaches, and mantids. Insect smell: Madagascan cockroaches and water. Take home baby crickets to raise.
6 November	Insect control: ultrasonics and ultraorganics. Pheromones and flour beetles. Sticky traps. Count flour beetles.
13 November	Games with insects. Insect crafts. Insects as food.
20 November	Entomology review: "Who am I?" Count flour beetles: evaluate.
4 December	Summary of class and where do you go from here?

Coincidentally, I also have a student this term who has asked if she can help with the class in the Fall term. Four of the 36 students I've had in the class have graduated from Purdue and are now in their own classrooms in urban communities. Each of these students (now teachers) has contacted me seeking more information, specimens, activities to pass on to their students. All of them have insect colonies in their classrooms. All of their students will benefit to a significantly greater degree than if I gave a one-hour visit to their classroom to talk about urban pests!

I have not deluded myself. Teaching entomology to elementary grade teachers is the solution to neither our pest management nor education problems. The job of the elementary school teacher today is more difficult and less well rewarded. A majority of teachers state that their greatest reward comes when students learn more effectively (Kottkamp *et al.* 1986). They go on to report, however, that being underpaid is a major reason for leaving teaching (Kasten 1984). My class cannot address the issue of compensation. However, Cohn and Kottkamp (1993) echo the earlier work of Schaefer (1967) that schools must become "Centers of Inquiry"; places where teachers and students "collaboratively identify problems or questions that are critical for today and tomorrow's concerns." I do believe that my course helps teachers to move toward this type of program.

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