

AN EXAMINATION OF POLLUTION AWARENESS AND PREVENTION IN
MONTANA SECONDARY AGRICULTURAL EDUCATION PROGRAMS

by

Ben Anton Meyer

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Agricultural Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July, 2007

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Dr. Martin Frick

Approved for the Division of Agricultural
Education/Agricultural Operations Technology

Dr. Robert Gough

Approved for the College of Agriculture

Dr. Carl Fox

Approved for the Division of Graduate Education

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ACKNOWLEDGMENTS

The author wished to thank his graduate committee, Dr. Martin Frick, Dr. Carl Igo, and Dr. Michael Vogel. Dr. Frick's overall vision of the research project was paramount to the success of the thesis. Dr. Igo's attention to detail, clarity, and literary logic was vital in the writing process and was greatly appreciated by the author. Without Dr. Vogel the concept would not have existed. Dr. Vogel was outstanding technical help as well as a resource for content and overall foresight for the study.

Katie Cooper's help was valued throughout the author's master's degree program as was the advice of fellow graduate students Mary Anne Anderson and Assa Kante. Working with these individuals provided the author with a sounding board for ideas and resulted in an improved final project.

The author also wished to thank and recognize his wife and family for their support during the degree process. The author's wife gave of her time, career, and support to encourage the completion of the study and can not be thanked enough.

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ABSTRACT

The purpose of this study was to ascertain the levels of pollutants found in Montana's secondary agricultural education programs as well as the status of pollution prevention education that was being taught. The study was guided by three questions; what were the levels of pollutants that existed in Montana secondary agricultural education programs, what was the level of pollution prevention education that was taught in Montana secondary agricultural education programs, and what were the existing barriers to implementing pollution prevention in Montana secondary agricultural education programs?

A written survey was conducted with Montana's 84 secondary agricultural educators. The survey focused on seven content areas; demographics, engines/automotive laboratories, metals/welding laboratories, greenhouse laboratories, woods/construction laboratories, agronomy laboratories, and animal husbandry laboratories.

The data was analyzed to provide an overview of Montana's pollution prevention and waste management status in agricultural education. Of the 84 agricultural educators surveyed, a total of 68 useable surveys were returned for a response rate of 80.1%.

The results of this study provided new evidence about the state of pollution prevention and waste management practices in Montana's secondary agricultural education programs

CHAPTER 1

THE PROBLEM

Introduction to the Problem

From the Kyoto Treaty governing worldwide policy to a simple recycling bin located in the workplace break room, environmental concerns have existed as a part of everyday life. Linking environmental concerns to agriculture was natural in looking at this problem. Although industry was the common scapegoat for a rise in pollutants, agriculture has given cause to be concerned about the world's environmental issues.

The Pollution Prevention Act passed by the United States Congress in 1990 brought the notion of pollution prevention and education to the forefront of workplace and industry agendas. Agricultural education programs, located in 7,242 secondary schools across America and in 77 secondary schools in Montana, were a direct link between hands-on environmental education and real-world practical application of skills and methodology.

School administrator, writer, and former agricultural educator Robert Williams noted in *The Agricultural Education Magazine* that an integrated approach was vital when teaching about agriculture and environmental concerns.

If agricultural educators recognize these concerns and teach their students how to develop solutions to these problems through the application of scientific principles, then the students, the agricultural industry, and the profession of agricultural education will all benefit (1993, p.5).

Bass (2000) suggested that creating a direct link between agricultural education and pollution prevention education could be considered a positive move for the field of agriculture. However, preliminary research showed that what was taught in the area of responsible environmental risk management and pollution prevention wasn't always what was modeled in the agriculture classroom and lab setting.

The Need for the Study

The importance of pollution prevention education was not a new or novel idea, yet it was often overlooked in the struggle to meet everyday curriculum and academic standards. Understanding the importance of pollution prevention education was easy but finding curriculum for educators in agriculture was not.

Traditionally, pollution prevention education has been conducted in an "end of pipe" style. Pollution prevention and/or waste minimization assessments at a business with subsequent training and retraining of their employees is needed in the United States. However, this type of training is "end of pipe" pollution prevention education. To provide for the greatest impact, pollution prevention education and training must be conducted at the academic institutions that prepare students for the jobs of tomorrow (Boon, 1997, p. 27).

Of the articles published in the *Journal of Agricultural Education* from 1986 to 2007, only 11 dealt with environmental issues. The need for coherent, well-defined pollution prevention education research was not only relevant but also a necessity in the nation's secondary agricultural education programs.

In 1990, the Environmental Protection Agency (EPA) commented on the importance of practicing and teaching pollution prevention in the educational setting.

Waste minimization awareness can be instilled and propagated by educational institutions, so that today's students and tomorrow's professionals can apply pollution prevention in their endeavors. Hence the importance of instituting pollution prevention within research and educational organizations cannot be overstated (Environmental Protection Agency, 1990b, p. 1).

In addition, according to Bass agricultural educators' role in pollution prevention and waste management, "has not been examined well at all" (2000, p. 4). An additional call for the importance of this study can be found in Radhakrishna and Xu's 1997 work. The authors reported that research on pollution prevention within the realm of agricultural education was non-existent, and were simply listed as, "emerging topics or other" (p. 62) when suggested as a teaching discipline within agricultural education. Since Radhakrishna and Xu's 1997 work, only two articles in the *Journal of Agricultural Education* have been associated with environmental issues. Nordstrom, Richards, Wilson, Coe, Fivek, and Brown (2000) of The Pennsylvania State University published an article relating to student attitudes about natural resource use and Cox, Lawver, Baker, and Doerfert (2004) of Texas Tech University published an article examining critical water and environmental related curriculum needs as perceived by agricultural educators within in the Ogallala Aquifer.

One can start to grasp the importance of this research and how it related to agricultural education by simply looking at the facts as stated in the EPA's 1990 bulletin on pollution prevention in research and educational institutions.

- 1) The oil from a single oil change can render 1 million gallons of water unusable for human consumption;
- 2) Oil concentrations as small as 50ppm in a sewage treatment system can ruin the treatment process;
- 3) Oil concentrations as low as 310ppm can cause serious long-term effects to freshwater fish (Environmental Protection Agency, 1990a, p. 4).

Since there was a link between what was modeled in the agricultural education laboratory facility and what was practiced at home by students (Phipps & Osborne, 1988 and Talbert, Vaughn, Croom, & Lee, 2007), it was imperative to examine the connection between the environmental risk and pollution management instruction and instructor behaviors and habits within the focused area. Through the study the question was asked, what are the factors and operations that influence pollution prevention and waste management in Montana secondary agricultural education programs?

Statement of Purpose

The purpose of this study was to examine and determine the practices and behaviors directly affecting pollution and environmental risk in Montana's secondary agricultural education laboratories. Secondly, a comprehensive overview of the exact

amount of useable and unusable chemicals was generated through the study period helping to define problem areas of concern in each specific laboratory. This purpose specified three objectives.

Objectives

1. Determine the levels of pollutants that existed in Montana secondary agricultural education programs;
2. Identify the level pollution prevention education that was taught in Montana secondary agricultural education programs;
3. Determine the existing barriers to implementing pollution prevention in Montana secondary agricultural education classrooms.

The Limitations

The following limitations existed for this study:

- i. The survey population was limited to agricultural educators in Montana employed in the 2006-2007 school year.
- ii. Survey respondents were trusted to accurately report pollutants found in their agricultural education programs.

The Assumptions

- i. Environmental risks were inherent in the agricultural education lab setting.

- ii. Agricultural education facilities were not in compliance with pollution prevention standards and agricultural education instructors did not always follow pollution prevention best practices.

The Definition of Terms

Waste – unusable or by-product materials generated in a production process (Cerrato, 2001).

Used Chemicals – products that have been used and/or stored in an unsealed container.

Pollution Prevention – engaging in efforts or activities that make a conscious or considerable effort to lessen the effects of environmental pollutants and risks (Theodore & McGuinn, 1992).

Waste Management – methods of recycling or disposing of waste and surplus materials after they are no longer of useful means (Wilson, 1981).

Environmental issues/concerns – pollutants and natural risks generated within agriculture and agricultural education with scientifically valid problems for potential problems for the natural environment.

CHAPTER 2

THE REVIEW OF LITERATURE

Aside from Bass' work in 2000 there was limited research available on pollution prevention, waste management, and environmental risk factors in secondary agricultural education programs. Paulter (1971) noted that teachers of laboratory-based classes required more organization and management procedures than those educators of non-laboratory classrooms. Studies have been conducted on the competencies related to agricultural education mechanics laboratory student performance, yet the field lacks research in agricultural education laboratory management outside of the mechanics laboratory and especially in management of pollutants.

Jewell (1987) reported that proper organization of an agricultural education program's laboratory space was the subject which North Carolina school administrators most frequently cited as being deficient in the performance of their agriculture teachers. Foster and Riesenber (1985) found that high school administrators in Idaho rated laboratory organization as a high indicator of overall agricultural education program quality. These examples of research are relevant to this study as they quantified and placed levels of importance on various factors within the agricultural education laboratory facilities.

Volumes of text have been researched and written regarding pollution in agriculture and there was research linking what was taught in the agricultural education laboratory to skills practiced by students. The review of literature included six areas: (a)

environmental risk – risk management, (b) pollution control, (c) pollution education, (d) pollution in agricultural education, (e) Occupational Standards Health Administration (OSHA) and other regulatory standards for schools and agricultural education programs, and, (f) pollution prevention in school-based, non agricultural education laboratory settings.

Environmental Risk – Risk Management

Environmental risk encompasses the notion that, with the forward progression of technology and mankind, the environment is unduly exposed to increasingly greater harmful risks caused by man. In agriculture, these risks have been the topic of debate for the majority of the past century (Loehr, 1977). Unfortunately for agriculture, more was expected from the industry while the industry faced declining land availability and fewer operators in the field (United States Department of Agriculture Natural Resources Conservation Service, 2003). Greater environmental risk caused by the increasing expectations of output in the industry of agriculture was all but inherent. These increased expectations must be dealt with in a matter that continues agricultural production while ensuring environmental safeguards (Romstad, 2004). Environmental risk was too often ignored because it wasn't readily observed. It was easy to disregard because it is often put off as a "down the road" type of a problem (Wilson, 1981).

Pollution Control

Pollution control was the idea that pollutants, in a variety of forms, will continue to exist. Control of these pollutants can be achieved through education and management (Press & Mazmanian, 2006). Enhancement of environmental quality in all sectors of industry and life was an accepted national goal under these premises. Raymond Loehr, noted environmental engineer at Cornell University, made the following observation.

The quantity of wastes generated by agriculture and specific environmental problems that have resulted from agriculture operations have illustrated that greater emphasis must be given to the management of agriculture residues and by-products (Loehr, 1977, p. xi).

Ongoing research in the field of pollution in agriculture has come with great debate as the world's population has increased a demand for more food has been seen. This has resulted in increased environmental degradation at the expense of food production (Loehr, 1977).

Shortle and Griffin made an interesting note that, "agriculture is a major cause of water quality pollution" (2001, p. xi). These noted agricultural economics researchers found that even in large industrialized countries major pollution issues existed in spite of financial persuasions provided to producers to diminish their output of agricultural pollutants.

Press and Mazmanian (2006) cited a need for increased governmental enforcement in working with business and industry for effective pollution control. Press and Mazmanian's research indicated an increase in successful pollution control when government entities imposed prescribed environmental regulations. The researchers reported that these regulations were effective when working with business and industry to find flexible methods that saved the industry and agricultural operator time and money. Further education was found to be a direct link to increased environmental consciousness and responsibility exhibited by those in industry. Ballantyne, Connell, and Fein (1998) reported that students taught environmental responsibility concepts were the catalysts for environmental change in various industry settings outside the classroom. This Australian study reported students more readily accepted environmental education and helped adapt their studies at school to their home environment.

Pollution Education

Pollution education, outside the context of environmental education, was a field within itself. In addition to government standards and market incentives, education about pollution was recognized as one of three main components designed to lessen pollution within agriculture (Ribaudo, Horan, & Smith, 1999). Education about pollution was an emerging technique, introduced in the 1970s, as a first step in reducing pollution risks (Theodore & McGuinn, 1992). In the realm of agriculture and agricultural education Ribaudo et al. also stated, "Education is a popular approach to affecting agricultural practices for a number of reasons. It is less costly to implement than a cost share

program, and is easier to execute” (1999, p. 332). Additionally, other researchers reported that education can be effective in getting agricultural producers to adopt environmentally friendly practices (Bosch, Cook, & Fuglie, 1995).

Pollution in Agricultural Education

It was widely accepted that pollutants do exist in the agricultural mechanics, agronomy, woods/construction, metals/welding, greenhouse, and animal husbandry laboratories within secondary agricultural education programs. Bass reported a wide variety of common automotive and agricultural pollutants existed in Montana agricultural education laboratories (2000). Laboratories were vital for student learning and retention of knowledge within agricultural education (Roberts, 1971, Phipps & Osborne, 1988, Newcomb, McCracken, Warmbrod, & Whittington, 2004, and Talbert, et al., 2007). Bass discovered six key laboratory program areas existed in Montana, each with their own pollutants. These included; automotive labs, woods/construction labs, greenhouses, agronomy plots, animal husbandry farms, and metals/welding labs (Bass, 2000).

Agricultural education program laboratories were essential to the accepted problem solving approach found within agriculture. Roberts (1971) stated that most problems in agriculture lend themselves to study and experimentation within careful educational settings. This was the ideal setting for hands-on learning and increased retention of knowledge. Unfortunately, these settings were closely associated with the agricultural sources that generated many of the common pollutants found in the general agricultural sector and naturally had the potential to be stymied by the same problems

discussed earlier in this review of literature. For example, laboratories in agricultural education were best designed to mimic their real-world counterparts (Roberts, 1971). Animal husbandry and agronomy settings had the potential to generate similar environmental risks and pollutants as did full scale operations. Learning laboratories such as engines/automotive laboratories were important to effective agricultural education (Roberts, 1971 and Phipps & Osborne, 1988), but they also generated waste (Herren & Cooper, 2002).

Comprehensive studies of agricultural education mechanics laboratories have been performed to analyze the competencies and factors associated with properly run facilities. Some of the findings in this research were applicable to this study. Johnson and Schumacher in 1989 reported that the number two competency identified by the nation's agricultural education mechanics specialists was the proper storage and safety of hazardous laboratory chemicals. The maintenance of healthy environmental conditions ranked twelfth in Johnson and Schumacher's findings out of 50 concerns. Both of these findings supported the challenge of pollutant and environmental risk issues within the agricultural education laboratory facility.

Of equal importance was Ullrich, Hubert, Murphy, Lindner, and Nalbone's, (2001) conclusions of their study that looked at 100 agricultural educators and their programs in Texas. Ullrich et al. set out to examine the status of safety within agricultural mechanics programs in Texas. From the data they concluded,

These (mechanics, greenhouse, agronomy, and animal science) laboratory settings bring with them additional requirements for safety instruction in chemical handling and biological containment. Given the importance of the role, it was disappointing to find the secondary education programs surveyed here lacked a focus on safety and safety education and teachers generally did not seek safety related training from business and industry sources (2001, p. 303).

Dyer and Andreasen's study of safety issues in agricultural education laboratories also drew concerns regarding the lack of agricultural mechanics laboratory safety issues. These researchers synthesized existing research about laboratory safety issues in agricultural education and noted that, "generally, teachers appear to be remiss both in their knowledge of local, state, and national safety laws and in their performance in providing a safe environment for themselves and their students" (1999, p. 50). Dyer and Andreasen's research acknowledged a link between existing risks in agricultural education laboratories including chemicals and waste products and potential safety issues for students and instructors.

OSHA Standards for Pollution in Agricultural Education

Researchers have acknowledged a need for agricultural education laboratories and their accompanying pollutants. With this understanding the question was raised as to what was acceptable in terms of pollutants in the educational setting. Indoor air quality was a concern in all non-industrial environments (Spengler, Hallowell, Moschandreas, & Fanger, 1982). The United States EPA established National Ambient Air Quality

Standards for the general population and public facilities (Parsons, 1997 and School Safety, n.d.). In educational facilities these standards were higher and did relate to air pollutants found in agricultural education laboratory facilities and their ventilation rates. “ASHRAE (American Society of Heating Refrigeration and Air Conditioning Engineers) Standard 62-1999 recommended the following in their standards guide for air ventilation.

A minimum ventilation rate of 15 cubic feet per minute (cfm) per person for classrooms is needed. Given typical occupant density of 33 persons per 1000 square feet and a ceiling height of 10 feet, the current ASHRAE standard would require an air exchange rate of about 3 air changes per hour (ACH) for a classroom.” (Daisey, Angell, & Apte, 2003).

This ASHRAE standard was important to note because the congruent standard for other public buildings is between 0.5 and 1.0 air changes per hour (Parsons, 1997). The EPA recognized that pollution control and air quality was an issue in agricultural education laboratories. In fact, agricultural education labs have been identified as producing hazardous waste in teaching activities (Environmental Protection Agency, 1990).

As for solid wastes, Babin and McCann (1992) recognized that schools often unknowingly create waste in the production of art, shop, and other projects outside the realm of experiments in scientific laboratories. This work was important to note since most studies in the educational arena focus directly on the environmental risks found in biology and chemistry labs (Bass, 2000).

Pollution Prevention in School Based,
Non Agricultural Education Laboratory Settings

Pollution prevention in the realm of green chemistry and responsible environmental practices, “has evolved from its roots in academic research to become a mainstream practice supported by academia, industry, and government” (Hjeresen, Schutt, & Boese, 2000). Green chemistry is the, “use of chemistry for pollution prevention. More specifically, (green chemistry is) the design of chemical products and processes that reduce or eliminate the use or generation of hazardous substances” (Environmental Protection Agency, 2002a). The EPA and the United States Department of Education recognized that schools generate pollutants through laboratory experimentation and educational processes. In fact, the EPA along with the Office of the President of the United States have offered monetary awards to students and teachers through the Presidential Green Chemistry Award (Environmental Protection Agency, 2003) in an effort to promote green chemistry and environmental stewardship in the classroom/laboratory environment.

As far back as 1985, the American Chemical Society (ACS) recognized the risk associated with educational laboratory chemicals and experiments (Ashbrook & Reinhardt, 1985). Ashbrook and Reinhardt in the ACS’s *Environmental Scientific Technology Journal* stated, “the wastes (generated in academia laboratory settings) consist of nearly every hazardous chemical listed by EPA, including hydrochloric acid,

methanol, polychlorinated biphenyls (PCBs), and newly synthesized compounds of unknown toxicity. Moreover, their composition changes with each new research project and experiment” (1985, p. 1150). The recognition of this environmental concern over 20 years ago has resulted in successful practices implemented to curb school laboratory generated pollutants.

The EPA has developed and implemented curriculum for teachers of chemical and biological sciences. This curriculum has reduced school generated pollutants and the use of environmentally degrading chemicals when there is an equally suitable, less degrading, chemical available for experimentation purposes (Environmental Protection Agency, 2002b). This tied to Bass’ findings that green chemistry and measures of pollution prevention are found in classroom settings in the traditional sciences, but lack in agricultural education laboratory settings (2000, p. 9).

According to Bass, standard science education in chemistry and biology, “has begun to recognize the need to control wastes that resulted from the educational process of conducting laboratory experiments and demonstrations” (2000, p. 2). This recognized need must be transferred to agricultural education laboratories. Even though activities in the laboratory setting lack the frequency and intensity of those mimicked in industry, the same caution, methods, and practices must be exercised in dealing with pollutants and environmental risks. Ultimately, the deficiencies in laboratory pollution prevention that Bass noted were relevant to this study. Research and the development of best management practices were needed in agricultural mechanics laboratories, greenhouses, and farm/field plots (Bass, 2000, p. 50).

CHAPTER 3

METHODOLOGY

The following methods were used to meet the objectives of this study. They were described within this chapter in four sections: (a) population description, (b) instrument design, (c) data collection methods, and (d) data analysis procedures.

Data was collected to make determinations about the practices of Montana's agricultural educators in regard to pollution prevention practices and their perceptions and knowledge of environmental risk factors associated with their agricultural education laboratories.

Population Description

Potential study participants were identified through the Directory of Montana Agricultural Educators, maintained by the Montana State FFA Center for Agricultural Education Office at Montana State University (Appendix I). At the time of the study, the directory listed 84 teachers of agricultural education in Montana. Of those 84, three were faculty at a single program and 10 were members of two-teacher programs, which resulted in 77 individual agricultural education programs around the state. All instructors of agricultural education were contacted for participation in the study. Each teacher was instructed to answer the questions specifically as they pertained to his/her teaching assignment. This helped eliminate overlap of data from multi-teacher programs. The need to limit the study was defined as follows:

1. Those instructors employed as agricultural educators in Montana secondary schools in the school year 2006-2007:
2. Those instructors listed inclusively in the Directory of Montana Agricultural Education Programs updated in the fall of 2006.

Instrument Design

The survey was heavily weighted with questions from which respondents could select an answer from a group of choices (see Survey, Appendix E). Most commonly, choices for answers were limited to four selections in all areas except for demographics. The survey was divided into seven categories: general information/demographics, engine and automotive laboratories, metals and welding laboratories, greenhouse laboratories, woods and construction laboratories, agronomy-based farm laboratories, and animal husbandry-based farm laboratories. All participating respondents were asked to complete the general information/demographics section and any subsequent sections that pertained to their direct teaching assignment.

The survey was constructed with a combination of multiple choice questions and open-ended questions. Question format was chosen based on the appropriateness for the type of answer possibilities and to maintain the highest level of instrument validity.

The survey was reviewed by a panel of experts at Montana State University consisting of agricultural education faculty and personnel from the Montana State

University Extension Office for Housing and Environmental Health who provided expert validation. This panel made recommendations and corrections to ensure a useable and balanced instrument was administered to the participants. After approval by the panel at Montana State University, the survey instrument was approved by the Montana State University Institutional Review Board on October 11, 2006 (Appendix A).

A pilot study consisting of agricultural educators in California and North Dakota was conducted to provide validity and reliability for the survey instrument. In all, 15 out-of-state agricultural educators were administered the pilot survey (see appendix F). Twelve (80%) teachers returned the instrument completed with commentary and suggestions.

Data Collection Methods

The data for this study was collected using a mailed and personally distributed survey instrument. The following distribution timeline was developed and adhered to during the collection process.

1. October 19, 2006 – survey consent read to attendants at the Montana Association of Agricultural Educators (MAAE) Fall Conference and survey distributed (Appendix B);
2. November 4, 2006 – survey consent read and survey distributed to educators who were present at Montana State University Ag Days who were not present at

the MAAE Fall Conference;

3. November 13, 2006 – cover and consent letter, along with the survey, sent out to all educators missed in the previous two distribution attempts (Appendix C);
4. December 1, 2006 – late response email reminder sent via the state’s MetNet electronic list serve for agricultural educators (Appendix G).

As previously stated, a total of 84 surveys were distributed to agricultural educators across the state of Montana. A cover letter and consent form accompanied each mailed survey instrument while the consent statement was read aloud to those educators approached in person which gave them the option to decline participation. Mailed surveys were distributed with a self-addressed return envelope. Postage was not affixed to this envelope.

Data from returned surveys was entered into Microsoft Excel. Comments and answers to open ended questions were typed in Microsoft Word and can be seen in Appendix H.

A final response rate of 83.3% (70 of 84 surveys) was obtained. For data analysis purposes, a useable response rate of 80.1%, (68 of 84) possible responses was used in this study due to the fact that two of the returned surveys were unusable due to the respondent incompletely filling out the survey. As Gravetter and Wallnau (2006) pointed out, there is no desirable method for dealing with missing data.

Because the survey was divided into specific sections for each laboratory area, respondents were instructed to only complete the section(s) that applied to their teaching assignments. This resulted in an expected outcome of fewer than the entire 68 respondents filling out all sections in the survey. Therefore, the total number of responses for each section varied from nine to 62 depending on the laboratory area. This variance was reflected in the frequency total for each question in each table and figure. Percentages listed in each table were then directly proportionate to the frequency total of the respective table.

Eighty-four surveys were distributed by mail and in person to the agricultural educators identified in the Directory of Montana Agricultural Educators provided by the Montana State FFA Office. Two requests for an additional copy of the survey were made due to the respondent misplacing the original survey. All surveys were assumed to be properly delivered as none were returned due to problems with the United States Postal Service.

Table 1 showed the return rate of the surveys over the survey distribution period during the fall of 2006. Surveys were initially distributed at the MAAE Fall Conference business meeting on October 19, 2006 where 40 surveys were completed and returned in person to the researcher for an initial response rate of 47.6%. Some of the agricultural education instructors from around the state were in Bozeman November 4-5, 2006 for MSU Ag Days. At MSU Ag Days the researcher reminded the instructors, in person, of the survey. This resulted in the return of five survey instruments or 6.0% of the total

responses. Respondents participating in the study were read the consent information included in Appendix D and voluntarily signed their consent accordingly.

On November 13, 2006, all remaining non-respondent agricultural educators were mailed a copy of the survey instrument (Appendix E), cover letter (Appendix C), consent form (Appendix D), and self addressed return envelope. This mailing resulted in 17 surveys being submitted or 20.2% of the total overall submission percentage. On December 1, 2006, an e-mail reminder (Appendix G) was sent via the state's MetNet list-serve. This late response e-mail reminder resulted in a eight surveys being submitted or 9.5% of the total. Overall, 70 of 84 surveys were submitted (83.3%) by agricultural educators in Montana.

Table 1. Survey responses over time.

	Date	N	Returned	Percent
At MAAE Fall Conference	October 19, 2006	84	40	47.6
After MSU Ag Days Reminder	November 4, 2006	--	5	6.0
After reminder e-mail via MetNet	November 13, 2006	--	17	20.2
After late response date	December 1, 2006	--	8	9.5
Total			70*	83.3

* Two of the 70 surveys were not useable for the purposes of this study.

Data Analysis Procedures

All data was analyzed using Microsoft Excel and SPSS statistical software. Early and late respondents were evaluated for statistical differences using an independent samples t-test. Gravetter and Wallnau (2006) noted that an independent samples t-test with an alpha level of .05 is a desirable means of either rejecting or accepting a null

hypothesis for statistical differences between early and late responders using selected data. For this study, the hypothesis stated that there would be no significant statistical difference between early and late respondents when analyzing their responses to questions regarding their past exposure to pollution prevention and environmental risk management education. Nominal data questions in the survey were not used for this test because differences were expected in respondents' quantities and types of chemicals found in their laboratories.

When analyzing eight of the earliest respondents and the eight late respondents, 60 answers were used to calculate results from an independent samples t-test. After establishing an alpha level of .05, a t result of -1.172 and a two-tailed probability of .245 was calculated. Both of these figures fell well within the acceptable levels of -1.96 to 1.96 for the t-test result and the two tailed probability of .245 was well above the alpha level of .05 indicating that the hypothesis could be accepted; therefore, early and late respondent's results were combined together for analytical purposes.

CHAPTER 4

RESULTS OF THE STUDY

This study focused on the three major objectives outlined in Chapter I; identifying the exact pollutants and their quantities found in Montana agricultural education programs, uncovering the current status of pollution prevention that is being taught in Montana agricultural education programs, and naming and identifying barriers that prevent pollution prevention implementation in Montana agricultural education classrooms and laboratories. The data from the study were divided into seven sections: 1) Demographics, 2) Engine and automotive laboratories, 3) Metals/welding laboratories, 4) Greenhouse laboratories, 5) Woods and construction laboratories, 6) Agronomy-based farm laboratories, and 7) Animal husbandry-based farm laboratories.

Demographic Data

Figure 1 represented the school size of respondents' programs. Schools sizes were based on 2006-2007 Montana High School Association (MHSA) guidelines. The MHSA defined schools based on the following classifications: Class AA 826+ students, Class A 340-825 students, Class B 120-339 students, and Class C 1-119 students. Four respondents taught in Class AA schools (5.9%), eight educators taught in Class A schools (11.8%), 22 respondents taught in Class B programs (32.4%), and the largest group of respondents, 33, taught in Class C schools (48.5%).

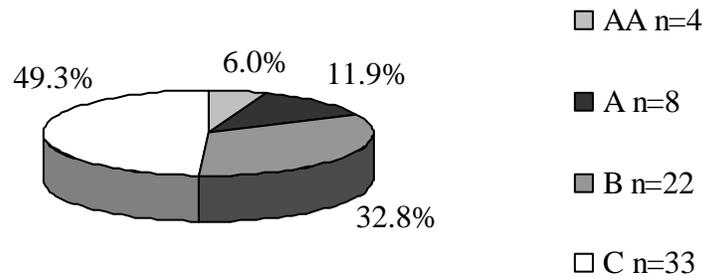


Figure 1. MHS class size school representation of survey respondents.

Gender of respondents was reported in Table 2. This table showed the frequency of all respondents by gender. Response percentages were nearly equal with 20 of 24 (83.3%) female agricultural educators responding and 48 of 60 (80.0%) of male agricultural educators responding to the survey.

Table 2. Survey respondents by gender.

Gender	Frequency	Percent of <i>n</i>	N	Percent of N
Female	20	29.4	24	83.3
Male	48	70.6	60	80.0
Total	68	100.0	84	80.1

The age distribution of survey respondents was depicted in Figure 2. The majority of respondents were age 50 years or younger with almost an equal distribution between respondents aged 21-35 (41.2%) and respondents between the ages of 35-50 (38.2%). Rounding out the age distribution were 13 (19.1%) respondents between the ages of 51-65 and one respondent was over 65 (1.5%) years of age.

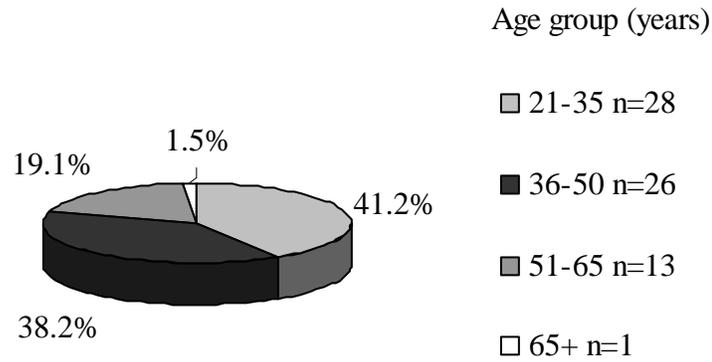


Figure 2. Age group distribution of survey respondents.

Figure 3 represented the highest college degree earned of all survey respondents. The overwhelming majority of respondents, 56 (82.4%) held at least bachelor’s degree whereas 12 (17.6%) held at least master’s degree. No survey respondents held a doctorate degree.

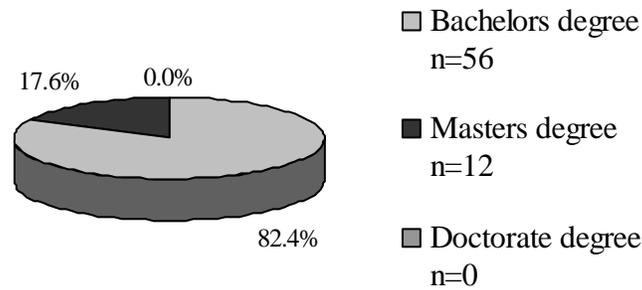


Figure 3. Educational level of survey respondents.

Community population size of survey respondents was found in Table 3. Respondents were asked to define their community in which they taught based upon their

own estimation using year 2000 U.S. Census data. The majority of respondents (58.8%) taught agricultural education in communities of fewer than 2,000 people. Eleven (16.2%) were instructors in a community of 1-200 persons. Eleven (16.2%) taught in communities of 201-500 people. In communities of 501-1,000 people, six respondents (8.8%) taught agricultural education. Twelve respondents (17.6%) were instructors in communities of 1,001-2,000 people and the largest sector of respondents 13 (19.1%), taught in towns of 2,001-4,000 people. Six respondents (8.8%) categorized their community size as 4,001-6,000 people and three respondents (4.4%) listed their community size as 6,000-10,000 people. Finally, four respondents (5.9%) listed a community of 10,000+ as the size of city in which they were an agricultural education instructor. Two (2.9%) respondents provided no response.

Table 3. Respondents' community population in which they teach agricultural education.

Estimated population	Frequency	Percent
1-200	11	16.2
201-500	11	16.2
501-1,000	6	8.8
1,001-2,000	12	17.6
2,001-4000	13	19.1
4,001-6000	6	8.8
6,000-10,000	3	4.4
10,000+	4	5.9
No Response	2	3.0
Total	68	100.0

Respondents were asked to list their years of public school teaching as shown in Table 4. The majority of respondents, 36 (52.9%), had taught ten years or less. Thirty

respondents equally listed their teaching experience between, 11-20 (22.1%) years of experience and 21-30 (22.1%) years of teaching experience. One respondent (1.5%) had between 31-40 years of teaching and another single respondent (1.5%) had over 41 years of teaching experience.

Table 4. Years of teaching experience of respondents.

Years of experience	Frequency	Percent
0 to 10	36	52.8
11 to 20	15	22.1
21 to 30	15	22.1
31 to 40	1	1.5
41+	1	1.5
Total	68	100.0

Table 5 data showed the occurrence of pollution prevention and waste management training related to agricultural education as received by respondents during their collegiate careers. Ten survey respondents (14.7%) indicated that they had received some pollution prevention training while in college whereas 85.3% ($n=58$) received no pollution prevention training in college.

Collegiate level waste management training offered similar data to that of collegiate pollution prevention training. Fourteen (20.6%) respondents indicated they received waste management training in college whereas 79.4% ($n=54$) had not.

Table 5. Collegiate level pollution prevention and waste management training of respondents.

	Pollution prevention training in college		Waste management training in college	
	Frequency	Percent	Frequency	Percent
Yes	10	14.7	14	20.6
No	58	85.3	54	79.4
Total	68	100.0	68	100.0

Table 6 followed the theme outlined in Table 5. Survey respondents were asked to indicate any professional in-service pollution prevention and waste management training they had received in their careers as agricultural educators. Sixteen (23.5%) had received some in-service pollution prevention training while one more respondent (25.0%) had received some in-service waste management training. The majority of respondents 76.5% ($n=52$) had never received any in-service pollution prevention training whereas 75.0% ($n=51$) had never received any in-service waste management training.

Table 6. Professional in-service pollution prevention and waste management training of respondents.

	In-service pollution prevention training		In-service waste management training	
	Frequency	Percent	Frequency	Percent
Yes	16	23.5	17	25.0
No	52	76.5	51	75.0
Total	68	100.0	68	100.0

Respondents' frequency of laboratory areas and their type was reported in Table 7. A total of 223 teaching laboratories were maintained by 68 survey respondents. Each agricultural educator maintained approximately three ($M=3.28$) laboratory teaching facilities. The most common laboratory was the metals/welding space with 91.2% ($n=62$) of educators reported utilizing this laboratory. Following was the woods/construction laboratory space with 57 teachers (83.3%). Ranked third was the engines/automotive laboratory with 76.5% ($n=52$) of teachers who taught in this space. The second half of the laboratory spaces were greenhouses with 30 (44.1%) respondents, animal husbandry laboratories with 13 (19.1%) educators, and agronomy laboratories with nine (13.2%) respondents.

Table 7. Type of agricultural education laboratory and frequency of respondents.

Type of laboratory program	Frequency	N	Percent
Engine/automotive	52	68	76.5
Metals/welding	62	--	91.2
Greenhouse	30	--	44.1
Woods/construction	57	--	83.8
Agronomy	9	--	13.2
Animal husbandry	13	--	19.1
Total	223	N/A	N/A

Survey respondents were asked to provide the exact number of students they taught in their agricultural education classes and the exact number of those students who were instructed in one of the six designated agricultural education laboratory settings. Respondents indicated a total of 3,484 students were in their agricultural education

classes each day while 3,243 student (93.1%) were exposed to laboratory-based instruction sometime during their course of instruction. Figure 4 illustrated this data.

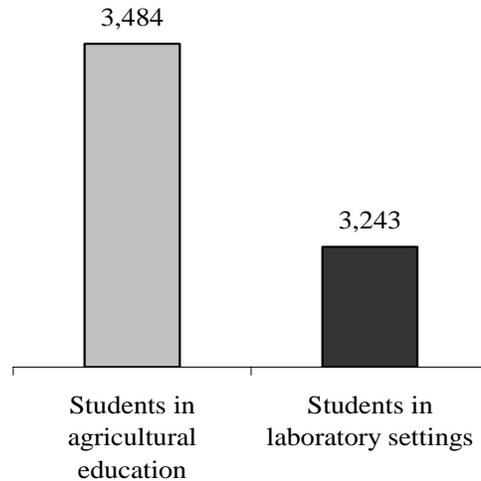


Figure 4. Unduplicated students in agricultural education and in agricultural education laboratory settings.

Table 8 showed respondents' interest in further training and education in pollution prevention and waste management for agricultural education. Almost half, 33 (48.5%) respondents, indicated they would take part in training offered at the Summer Update Conference of the MAAE. Twelve (17.6%) respondents noted they would only attend training if it were offered no more than two hours from their agricultural education program. Eleven (16.2%) respondents indicated they would only attend a training if it was free whereas one (1.5%) respondent noted that he/she would agree to attend a training if it were offered for less than \$100. Five (7.4%) respondents would only attend a

training if Montana Office of Public Instruction renewal credits were offered whereas six (8.8%) indicated they would not attend a training under any of the above circumstances.

Table 8. Respondents' training and venue options for pollution prevention and waste management education.

Training options and venue	Frequency	Percent
Offered at MAAE Summer Update Conference	33	48.5
Offered no more than two hours from home program	12	17.6
Only if the training was free	11	16.2
Only if the training was less than \$100	1	1.5
Only if renewal credits were offered	5	7.4
Would not attend under any of the given circumstances	6	8.8
Total	68	100.0

Engine/Automotive Laboratories

Fifty-two respondents answered this portion of the survey. Respondents were asked to list the volume, in gallons, of new and open/used chemicals they maintained in their engine and automotive laboratories on a consistent basis. In total 1,019 gallons of new chemicals were identified while 1,385 gallons of used/open chemicals were acknowledged. Engine oil led all other new automotive chemicals with 247.5 (24.3%) gallons of new oil in laboratories and 960 (69.3%) gallons of used/open oil present in laboratory space. Other chemicals were as follows: fifty-two and one fourth (5.1%) gallons of new and 56 (4.0%) gallons of used/open transmission fluid, seventy-two (7.1%) gallons of new and 102 (7.4%) gallons of used/open antifreeze, twenty and one

fourth (2.0%) gallons of new and six and three quarters (0.5%) gallons of used/open brake fluids, one hundred and eighty seven (18.3%) gallons of diesel/gasoline and 95 (6.9%) of used/open diesel/gasoline, four hundred forty and one half (43.2%) gallons of new and 165 (11.9%) gallons of used/open engine cleaning solvents. No volume of refrigerants, new or used/open, were reported. Table 9 summarized the data.

Table 9. Quantity of chemicals found in respondents' engines/automotive laboratories.

Chemical	New volume (gallons)	Percentage of total new chemicals found in the laboratory	Used/open volume (gallons)	Percentage of total used/open chemicals found in the laboratory
Oil	247.50	24.3	960.00	69.3
Transmission fluid	52.25	5.1	56.00	4.0
Antifreeze	72.00	7.1	102.00	7.4
Refrigerants	0.00	0.0	0.00	0.0
Brake fluid	20.25	2.0	6.75	0.5
Diesel/Gasoline	187.00	18.3	95.00	6.9
Engine cleaning solvents	440.50	43.2	165.00	11.9
Total	1,019.00	100.0	1,385.75	100.0

Respondents of this section were asked to disclose the length of time that they stored the used/open chemicals listed in Table 9 in their engines/automotive laboratory teaching space. Figure 5 illustrated the responses to this question. The majority of respondents stored used/open chemicals over one semester. Seventeen (32.7%) stored the chemicals at least one school semester, 13 (25.0%) stored chemicals for at least one year, and 14 (26.9%) stored engines/automotive chemicals in their laboratories for over one year. Three (5.8%) respondents kept used/open chemicals no more than one week

while another three (5.8%) respondents kept the chemicals no more than one month.

Two (3.8%) respondents to this section did not answer this question.

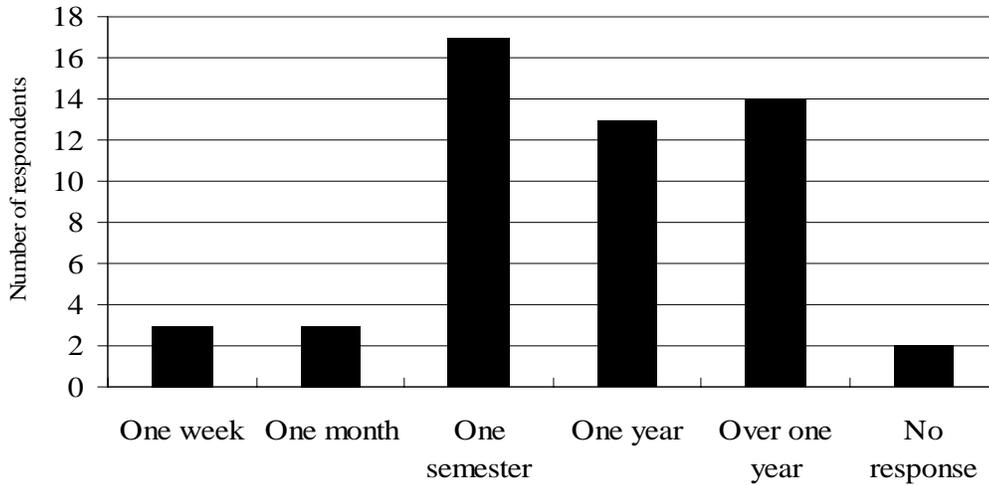


Figure 5. Length of time used/open chemicals were stored in engines/automotive laboratory spaces by respondents.

Related to stored chemicals in respondents' engines/automotive space was a question asked if all chemicals in this laboratory space were stored in their original containers. Figure 6 showed that results were almost split equally with 27 (51.9%) of respondents who stored chemicals only in their original containers and 25 (48.1%) of respondents who stored all engines/automotive chemicals in containers other than the original.

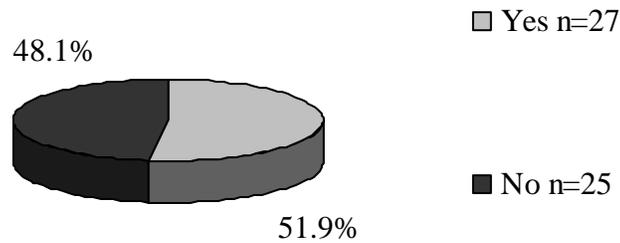


Figure 6. Occurrence of respondents who stored engines/automotive chemicals in their original containers.

Respondents in this section were asked to indicate if they had recycling options for engines/automotive waste chemicals in their communities. Fewer than half, 42.3% ($n=22$) had recycling options while 29 (55.8%) respondents indicated they did not have any engines/automotive chemical recycling options in their communities. One (1.9%) respondent did not answer.

Of the 22 respondents who indicated that they did have engines/automotive chemical recycling options in their communities, 17 (77.3%) claimed they utilized recycling opportunities regularly whereas two (9.1%) did not use their available recycling options. Three (13.6%) respondents did not answer this question. Data for community recycling options and usage of these options was delineated in Table 10.

Table 10. Respondents' community recycling options for engines/automotive chemicals and their usage.

	Recycling options in the community		Use of recycling option in the community when available to respondents	
	Frequency	Percent	Frequency	Percent
Yes	22	42.3	17	77.3
No	29	55.8	2	9.1
No response	1	1.9	3	13.6
Total	52	100.0	22	100.0

In relation to recycling options and opportunities, each respondent was asked to categorize the distance in miles to their nearest recycling center. Five (9.6%) respondents were within one mile while three (5.8%) were one to five miles from a recycling center. Seven (13.5%) respondents had to travel between six and twenty miles whereas 16 (30.8%) respondents were between 21 and 50 miles to the nearest recycling center. The largest sector of respondents, 38.5% ($n=20$) had to travel 51 or more miles to recycle wastes generated in their engine/automotive laboratories. One (1.9%) respondent did not answer this question. The data for this question were outlined in Table 11.

Table 11. Respondents' distance to engines/automotive waste recycling centers.

Distance to recycling center	Frequency	Percent
0-1 mile	5	9.6
1-5 miles	3	5.8
6-20 miles	7	13.5
21-50 miles	16	30.8
Over 51 miles	20	38.5
Non response	1	1.8
Total	52	100.0

Respondents with engines/automotive laboratories were asked if they had a spill containment structure in their facility. Thirty-one (56.9%) responded in the affirmative while 21 (40.4%) indicated they did not have floor spill containment structure. Of the 31 respondents who had such a structure, 13 (41.9%) had the containment structure serviced/cleaned at least once every school year. One (3.2%) educator had this structure cleaned/serviced each semester and five (16.1%) had the containment area cleaned/serviced at least once every three or more years. Ten respondents (32.3%) indicated they have not had their spill containment structure cleaned/serviced since they have been the instructor in their respective agricultural education program. Two (6.5%) respondents did not answer the question. Data for this survey question were illustrated in Figure 7.

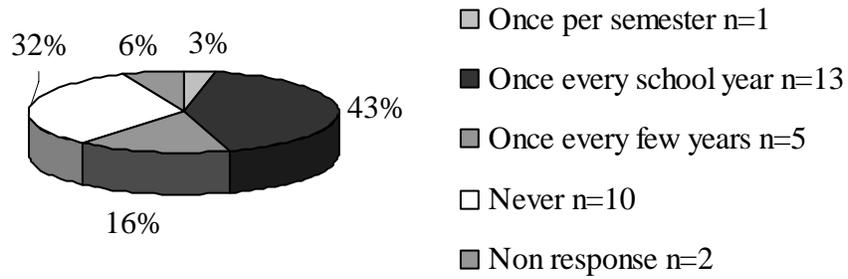


Figure 7. Frequency of respondents' cleaning/servicing spill containment areas.

Respondents were asked to quantify the type of solid waste their engines/automotive laboratory generated based on the following items: Used batteries, 14 (25.9%); Used oil/fuel filters, 30 (55.6%); Used tires, nine (16.7%), Air conditioner cores, one (1.9%). Respondents could select as many items as were appropriate for their laboratory. This data were reported in Table 12.

Table 12. Frequency of solid engines/automotive wastes generated by respondents.

Pollutants generated	Frequency	Percent
Used batteries	14	25.9
Used oil/fuel filters	30	55.6
Used tires	9	16.7
Air conditioning cores	1	1.8
Total	54	100.0

From the list of items in Table 12, respondents were asked to describe their method for dealing with these items as well as those in Table 9. The respondents' means of handling the wastes was listed below.

1. Used oil burned in a local business's oil burning stove ($f=11$)
2. Oil, call recycler and they pick it up ($f= 8$)
3. Students take home all waste they generate ($f= 5$)
4. Trash ($f= 5$)
5. Collect in barrel behind the shop ($f= 3$)
6. Batteries were taken to NAPA for recycling ($f= 2$)
7. Some oil spread on the road for dust control ($f= 2$)
8. Antifreeze in the dumpster, less than two gallons at a time
9. Oil filters were taken to the dump
10. Parts cleaner solution was water soluble, but has not been disposed of
11. Store long term
12. Take to my home and pour on my gravel road for dust control
13. Tires were used as feeders or taken to the tire shop
14. Truck to Great Falls takes to recycling center
15. Used oil filters were drained for four days then put in the trash
16. Used oil was mixed with sawdust and burned
17. Used oil was used as weed killer
18. Used oil was used for cutting oil
19. Used the waste oil at home

Respondents indicated the number of class periods they devoted to teaching chemical safety, chemical application, and chemical disposal in regard to the specific

laboratory in each section. In the area of engines/automotive laboratories, most educators spent one or zero class periods teaching about the areas noted in the survey. Fifteen (28.8%) respondents spent zero periods teaching engines/automotive chemical safety while 25 (48.1%) respondents devoted at least one period to the subject. Eleven (21.2%) respondents spent two to four periods teaching chemical safety whereas only one (1.9%) respondent devoted five or more class periods to the subject.

In the area of proper engine/automotive chemical application 10 (19.2%) respondents didn't devote any time to the subject at all whereas 48.1% ($n=25$) of respondents spent at least one class period on the topic. Sixteen (30.8%) respondents spent two to four class periods whereas a single respondent (1.9%) spent five or more class periods on engines/automotive chemical application.

Regarding engines/automotive chemical disposal, 44.2% ($n=23$) of respondents spent zero and one class period respectively on the subject. Four (7.7%) respondents devoted two to four class periods to the topic while one (1.9%) respondent covered the subject in five or more class periods. One (1.9%) respondent did not answer this question. Table 13 outlined the data for each of the three areas discussed above.

Table 13. Respondents' time devoted to teaching engines/automotive chemical application, safety, and disposal.

Class periods	Number of class periods devoted to teaching:					
	Engines/automotive chemical safety		Engines/automotive chemical application		Engines/automotive chemical disposal	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	15	28.8	10	19.2	23	44.2
1	25	48.1	25	48.1	23	44.2
2 to 4	11	21.2	16	30.8	4	7.8
5+	1	1.9	1	1.9	1	1.9
Non response	0	0.0	0	0.0	1	1.9
Total	52	100.0	52	100.0	52	100.0

Relationships Within Engines/Automotive Laboratories Data.

Statistically noteworthy within the data of engines/automotive laboratories was the relationship between gender and number of class periods respondents devoted to teaching chemical safety, application, and disposal within their engines/automotive laboratories. With a standard alpha level ($\alpha=.05$), and 52 respondents in the section, significant relationships were found within each of the surveyed teaching areas when compared to the gender of the respondents. Table 14 shows the means and standard deviations of the respondents' answers. Data for the mean value (M) was coded as follows; 1 = no time spent, 2 = one class period, 3 = two to four class periods, and 4 = five or more class periods.

Table 14. Number of class periods respondents devoted to teaching engines/automotive chemical related issues.

Number of class periods spent teaching:	<i>n</i>	<i>M</i>	<i>SD</i>
Engines/automotive chemical safety	52	1.96	.77
Engines/automotive chemical application	52	2.15	.75
Engines/automotive chemical disposal	52	1.73	.84

A statistically significant difference ($F_{df=3} = 8.03$; $p=.045$) was found between the mean levels of levels of gender and the respondents' time devoted to teaching engines/automotive chemical safety as indicated in Table 15. A similar difference ($F_{df=3} = 8.00$; $p=.046$) was found between gender and respondents' time devoted to teaching engines/automotive chemical application. Again, a statistically significant difference ($F_{df=4} = 9.78$; $p=.044$) was noted when comparing gender and respondents' time devoted to teaching engines/automotive chemical disposal.

Table 15. Significance levels within respondents' gender by engines/automotive chemical safety, application, and disposal.

Number of class periods spent teaching:	<i>df</i>	<i>F</i>	<i>Sig.</i>
Engines/automotive chemical safety	3	8.03 ^a	.045
Engines/automotive chemical application	3	8.00 ^a	.046
Engines/automotive chemical disposal	4	9.78 ^b	.044

^a. Four cells (50.0%) have expected count less than five. The minimum expected count is .21.

^b. Eight cells (80.0%) have expected count less than five. The minimum expected count is .21.

Metals/Welding Laboratories

Sixty-two (91.2%) respondents indicated the presence of a metals/welding laboratory in their teaching space. The 62 respondents of this section were asked to quantify, in gallons, the amount of chemicals present in their metals/welding laboratories. Results showed paint thinner was the most prevalent chemical with 62.75 gallons (56.0%) of new chemical and 56.5 gallons (48.0%) of used/open thinner found in the 62 respondent's laboratories. Ranked second was metal cutting oil with 30.63 gallons (27.3%) of new oil and 39.13 gallons (33.3%) of used oil in respondents' laboratories. Completing the list was paint stripper which accounted for 16.7% (18.75 gallons) of new chemical and 17.4% (20.5 gallons) of used/open paint stripper. Used/open foundry chemicals accounted for 1.5 gallons (1.3%) of chemicals present in metals/welding laboratories. No new volume of foundry chemicals was reported. Data of chemicals present in respondents' metals/welding laboratories is outlined in Table 16.

Table 16. Quantity of chemicals found in respondents' metals/welding laboratories.

Chemical	New volume (gallons)	Percentage of total new chemicals found in the laboratory	Used/open volume (gallons)	Percentage of total used/open chemicals found in the laboratory
Cutting oil	30.63	27.3	39.13	33.3
Paint thinner	62.75	56.0	56.50	48.0
Paint stripper	18.75	16.7	20.50	17.4
Foundry chemicals	0.00	0.0	1.50	1.3
Total	112.13	100.0	117.63	100.0

Respondents of this section were asked to disclose the length of time they stored the used/open chemicals listed in Table 16 in their metals/welding laboratory teaching space. Figure 8 illustrated the responses to this question. The majority of respondents stored used/open chemicals over one semester whereas seven (11.3%) stored chemicals at least one school semester, 21 (33.9%) stored chemicals for at least one year, and 20 (32.3%) stored metals/welding chemicals in the laboratories for over one year. Four (6.5%) respondents kept used/open chemicals no more than one week whereas another three (4.8%) respondents kept the chemicals no more than one month. Seven (11.3%) respondents to this section did not answer this question.

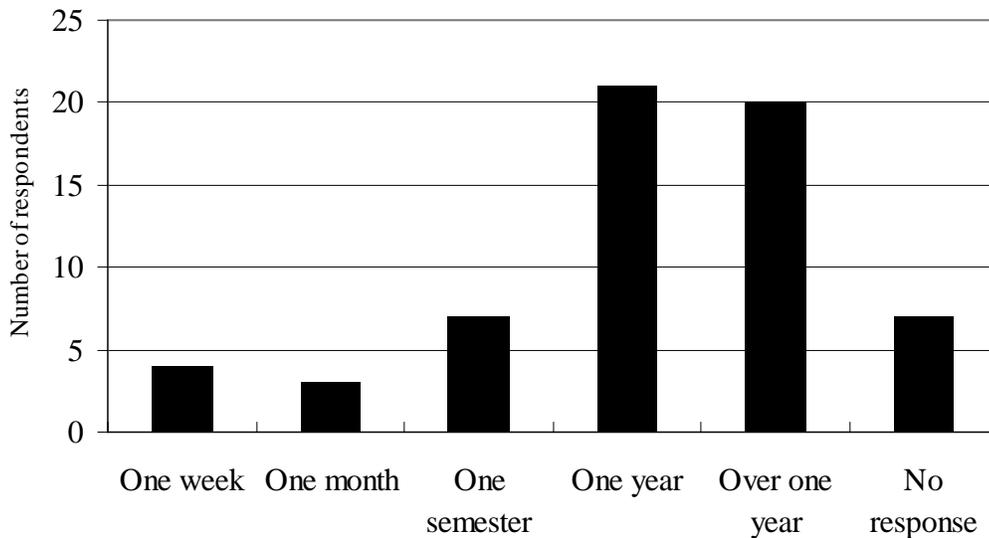


Figure 8. Respondents' length of time used/open chemicals were stored in metals/welding laboratories.

Respondents of this section were also asked how often they recycled scrap metal that was generated by the users of their metal/welding laboratory. The results revealed the majority of respondents, 56.5% ($n=35$) only recycled scrap metal once each school year and 32.3% ($n=20$) recycled scrap metal once a school semester. Only three (4.8%) respondents recycled scrap metal every month while four (6.5%) indicated they never recycled scrap metal generated in their metals/welding laboratories. A summary of data regarding the frequency of scrap metal recycling by respondents were reported in Table 17.

Table 17. Frequency of respondents who recycled scrap metal.

Frequency of recycling scrap metal	Frequency	Percent
Every month	3	4.8
Every semester	20	32.3
Each school year	35	56.5
Never	4	6.4
Total	62	100.0

Respondents with metals/welding laboratories were asked if they had an air ventilation system specifically in their welding/foundry area. Fifty-seven (91.9%) educators indicated they did, whereas four (6.5%) said they did not. One (1.6%) did not answer the question. Of the 57 respondents with a ventilation system, two-thirds (66.7%, $n=38$) indicated they had not had their ventilation system serviced since they had been employed in their respective school district. Ten (17.5%) respondents indicated they serviced their system yearly or more often while nine (15.8%) indicated they serviced

their ventilation system at least every three years. Data for this question is illustrated in Figure 9.

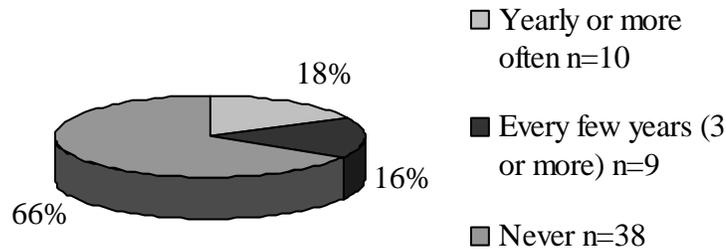


Figure 9. Frequency of servicing welding/foundry ventilation systems.

In the area of metals/welding laboratories, most educators spent two or more class periods teaching about pollution prevention and environmental risk. One (1.6%) respondent spent zero periods teaching metals/welding gas and chemical safety whereas 11 (17.7%) respondents devoted one period to the subject. A majority, 38 (61.3%) respondents spent two to four periods on chemical and gas safety whereas 10 (16.1%) respondents devoted five or more class periods to the subject. Two (3.2%) did not answer the question.

In the area of proper metals/welding chemical and gas application, six (9.7%) respondents did not devote any time to the subject at all while 27.4% ($n=17$) of respondents spent one class period on the topic. Twenty-seven (43.5%) respondents spent two to four class periods whereas 10 (16.1%) spent five or more class periods on metals/welding gas and chemical application. Again, two (3.2%) did not answer the question.

For metals/welding reuse and recycling practices, 40.3% ($n=25$) of respondents spent no class periods on the subject, while 22 (35.5%) respondents spent one class period on recycling and reuse practices in metals/welding laboratories. Eleven (17.7%) respondents devoted two to four class periods to the topic whereas two (3.2%) respondent covered the subject in five or more class periods. Two (3.2%) respondents did not answer this question. Table 18 outlined the data for respondents discussed above.

Table 18. Respondents' time devoted to teaching welding/metals gas and chemical safely and application and metals reuse/recycling practices.

	Number of class periods devoted to teaching:					
	Metals gas and chemical safety		Metals gas and chemical application techniques		Metals reuse/recycling practices	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	1	1.6	6	9.7	25	40.3
1	11	17.7	17	27.4	22	35.4
2 to 4	38	61.3	27	43.5	11	17.7
5+	10	16.1	10	16.1	2	3.3
Non response	2	3.3	2	3.3	2	3.3
Total	62	100.0	62	100.0	62	100.0

Greenhouse Laboratories

Thirty respondents indicated the presence of a greenhouse laboratory in their teaching space (44.1%). The 30 respondents of this section were asked to quantify, in gallons, the volume of the laboratory-related chemicals present in their greenhouse laboratory facilities. Results showed selective herbicides were the most prevalent chemical with 14.5 gallons (57.7%) of new chemical and 18 gallons (72.0%) of

used/open selective herbicide found in the 30 respondents' laboratories. Ranked second were fungicides with 4.13 gallons (16.4%) of new fungicide and four gallons (16.0%) of used/open fungicide in respondents' greenhouses. Non-selective herbicides accounted for 25.9% (6.5 gallons) of new chemical and 12.0% (3 gallons) of used/open non-selective herbicides. Data for gallons of chemicals that were present in respondents' greenhouse laboratories were found in Table 19.

Table 19. Volume of chemicals present in respondents' greenhouse laboratories (gallons).

Chemical (in gallons)	New volume	Percentage of total new chemicals found in the laboratory	Used/open volume	Percentage of total used/open chemicals found in the laboratory
Selective herbicides	14.50	57.7	18	72.0
Non-selective herbicides	6.50	25.9	3	12.0
Fungicides	4.13	16.4	4	16.0
Total	25.13	100.0	25	100.0

Fertilizer and insecticide weights were reported in pounds on hand. Table 20 reflects that fertilizers made up the vast majority of greenhouse chemicals with 523 pounds (89.0%) of new chemical and 402 pounds (88.6%) of used/open chemical. Insecticides accounted for a small portion of chemical poundage with 65 pounds (11.0%) of new chemical and 52 pounds (11.4%) of used/open chemical.

Table 20. Weight of chemical present in respondents' greenhouse laboratories (pounds).

Chemical (in pounds)	New weight	Percentage of total new chemicals found in the laboratory	Used/open weight	Percentage of total used/open chemicals found in the laboratory
Fertilizer	523	89.0	402	88.6
Insecticides	65	11.0	52	11.4
Total	588	100.0	454	100.0

Respondents were asked to disclose the length of time they stored the used/open chemicals listed in Table 19 and Table 20 in their greenhouse laboratory teaching space. Figure 10 illustrated the responses. The majority of respondents stored used/open chemicals over one year. Two (6.7%) stored the chemicals at least one school semester, 11 (36.7%) stored chemicals for at least one year, and 13 (43.3%) stored greenhouse chemicals in the laboratories for over one year. Two (6.7%) respondents kept used/open chemicals no more than one week whereas no respondents kept the chemicals no more than one month. Two (6.7%) respondents to this section did not answer this question.

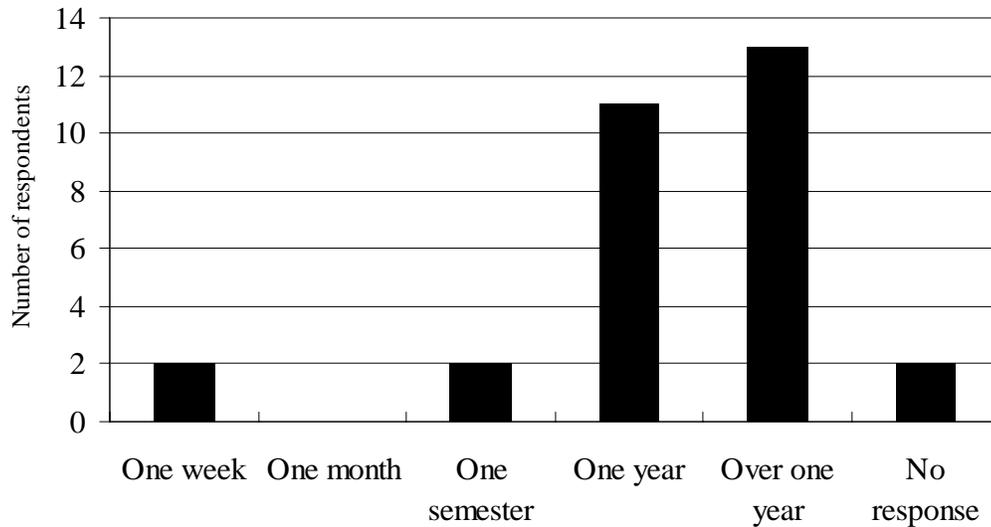


Figure 10. Length of time respondents stored used/open chemicals are stored in greenhouse laboratories.

In the area of greenhouse laboratories most educators spent one to four class periods teaching about pollution prevention and environmental risk concerns. Six (20.0%) respondents taught zero periods on the topics of greenhouse fertilizer and chemical safety compared to 13 (43.3%) respondents who devoted one period to the subject. Another 10 (33.3%) respondents taught two to four periods on fertilizer and chemical safety whereas one (3.3%) respondent devoted five or more class periods to the subject.

Three (10.0%) respondents did not use any instructional time on proper greenhouse fertilizer and chemical application at all whereas 43.3% ($n=13$) of respondents taught at least one class period on the topic. Eleven (36.7%) respondents taught two to four class periods compared to two (6.7%) who taught five or more class

periods on greenhouse fertilizer and chemical application. One (3.3%) respondent did not answer the question.

In regard to greenhouse fertilizer and chemical disposal techniques and methods, 33.3% ($n=10$) of respondents taught no class periods on the subject. Seventeen (56.7%) respondents spent one class period on greenhouse fertilizer and chemical disposal techniques and methods. One (3.3%) respondent devoted two to four class periods to the topic whereas one (3.3%) respondent covered the subject in five or more class periods. Again one (3.3%) respondent did not answer this question. Table 21 outlined the data for each of the three areas discussed above.

Table 21. Respondents' time devoted to teaching greenhouse fertilizer and chemical safety, application, and disposal.

	Number of class periods devoted to teaching:					
	Proper greenhouse fertilizer and chemical safety		Proper greenhouse fertilizer and chemical application techniques		Proper greenhouse fertilizer and chemical disposal methods	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	6	20.1	3	10.0	10	33.3
1	13	43.3	13	43.3	17	56.8
2 to 4	10	33.3	11	36.7	1	3.3
5+	1	3.3	2	6.7	1	3.3
Non response	0	0.0	1	3.3	1	3.3
Total	30	100.0	62	100.0	62	100.0

Woods/Construction Laboratories

Fifty-seven respondents indicated the presence of a woods/construction laboratory in their teaching space (83.8%). The 57 respondents for this section were asked to quantify, in gallons, the amount of chemicals present in their woods/construction laboratories. Results showed that paint was the most prevalent chemical with 255 gallons (51.9%) of new chemical and 375 gallons (56.2%) of used/open paint found in the 57 respondents' laboratories. Ranked second were wood stains with 107.75 gallons (21.9%) of new stains and 172 gallons (24.1%) of used/open stain in respondents' woods/construction laboratories. Solvents accounted for 14.6% (72 gallons) of new chemical and 10.7% (76.5 gallons) of used/open solvent. Glue and adhesives were the other chemicals found in respondents' wood/construction laboratories with 56.75 gallons (11.5%) of new chemicals and 90 gallons (12.6%) of used/open chemicals. Data for gallons of woods/construction chemicals present in respondents' woods/construction laboratories were found in Table 22.

Table 22. Volume of chemicals that were present in respondents woods/construction laboratories.

Chemical	New volume (gallons)	Percentage of total new chemicals found in the laboratory	Used/open volume (gallons)	Percentage of total used/open chemicals found in the laboratory
Paint	255.00	51.9	375.00	52.6
Solvents	72.00	14.6	76.50	10.7
Stains	107.75	21.9	172.00	24.1
Glue/adhesives	56.75	11.6	90.00	12.6
Total	491.50	100.0	713.50	100.0

Respondents of this section were asked to disclose the length of time that they stored the used/open chemicals listed in Table 22 in their woods/construction laboratory teaching space. Figure 11 depicted the responses to this question. The majority of respondents stored used/open chemicals over one year. Seven (12.3%) stored the chemicals at least one school semester, 16 (28.1%) stored chemicals for at least one year, and the majority, 32 (56.1%) stored woods/construction chemicals in the laboratories for over one year. No respondents kept used/open chemicals no more than one week whereas one (1.8%) respondent kept the chemicals no more than one month. One (1.8%) did not answer this question.

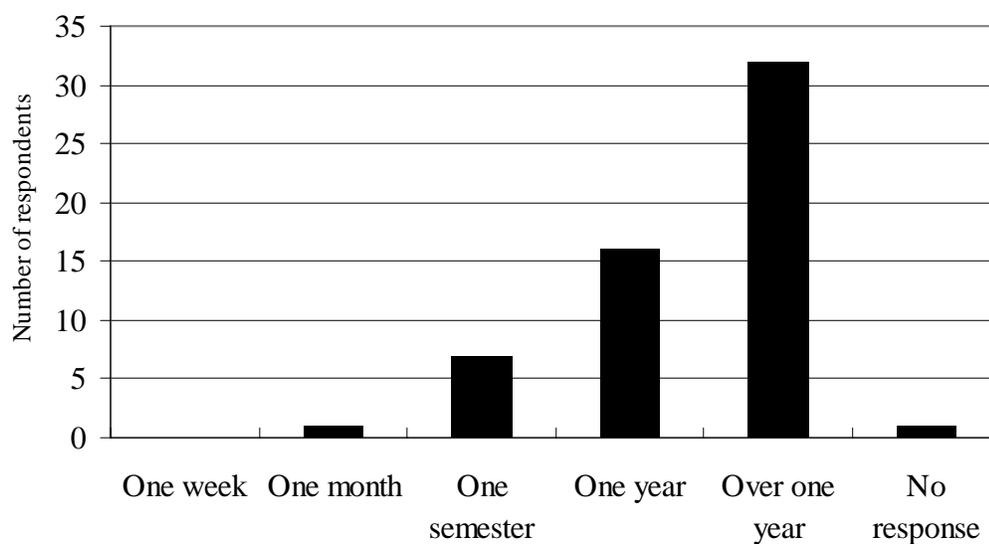


Figure 11. Length of time used/open chemicals were stored in respondents woods/construction laboratory space.

Respondents were asked if all chemicals in this laboratory space were stored in their original containers. Figure 12 showed that a vast majority, 50 (87.7%) respondents stored chemicals only in their original containers and seven (12.3%) respondents did not store all woods/construction laboratory chemicals in their original containers.

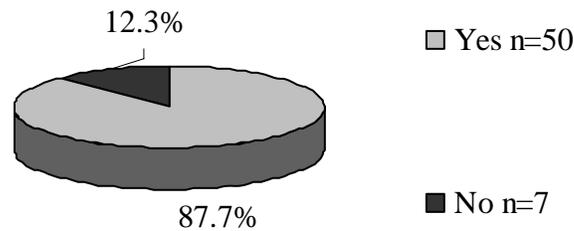


Figure 12. Frequency of respondents who stored chemicals in their original containers.

Related to the chemicals noted in Table 22, respondents were asked to list their means and methods of disposing leftover paint, stain, solvents, and other chemicals associated with their woods/construction laboratories. The survey question was open-ended which prompted sentence form answers from respondents. The list of respondents' methods is below.

1. Trash ($f = 16$)
2. Filled with sawdust and placed in dumpster ($f = 3$)
3. Leftover is sealed and used until gone ($f = 3$)
4. Custodian dealt with this ($f = 2$)
5. Left it open to dry out and then threw it away ($f = 2$)

6. Left open to dry out and then trash ($f = 2$)
7. Paint put in garbage solvents professionally disposed of ($f = 2$)
8. Poured it out onto waste cardboard outside. Once dry, dispose in the trash
($f = 2$)
9. Stored indefinitely ($f = 2$)
10. Applied to scrap wood and dispose of
11. Approved landfill disposal program
12. Community chemical disposal day
13. Green box
14. Improperly
15. Left to dry out and then trash
16. Sealed to prevent leakage and then place in dumpster
17. Used it up
18. Used them until they are gone or throw them away when not usable anymore
19. We did not have leftovers

Related to respondents' habits in their woods/construction laboratories, the survey inquired about respondents' recycled materials they no longer needed in their woods/construction laboratory. Six respondents (10.5%) indicated they did recycle while a majority 50 (87.7%) stated they did not recycle woods/construction materials. One (1.8%) did not answer this question. This data were illustrated in Figure 13.

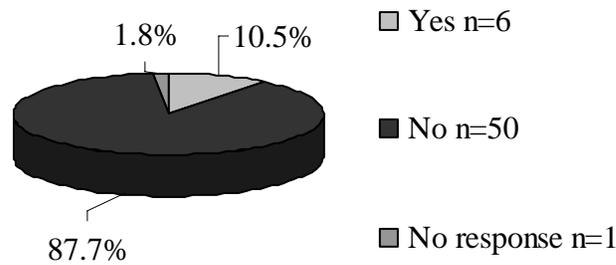


Figure 13. Frequency of respondents who recycled woods/construction materials.

In the area of woods/construction laboratories most educators taught one or no class period teaching about pollution prevention and environmental risk. Fifteen (26.3%) respondents spent zero periods teaching woods/construction chemical safety whereas 22 (38.6%) respondents devoted at least one period to the subject. Another 16 (28.1%) respondents spent two to four periods on chemical safety compared to four (7.0%) respondents devoted five or more class periods to the subject.

In the area of proper woods/construction laboratory chemical application, 10 (17.5%) respondents did not devote any time to the subject at all whereas 43.9% ($n=25$) of respondents spent one class period on the topic. Eighteen (31.6%) respondents spent two to four class periods whereas three (5.3%) spent five or more class periods on woods/construction chemical application. One (1.8%) respondent did not answer the question.

For teaching woods/construction chemical disposal techniques and methods, 43.9% ($n=25$) of respondents spent no class periods on the subject. Twenty-five (43.9%)

respondents taught at least one class period on chemical disposal techniques and methods. Four (7.0%) respondents devoted two to four class periods to the topic compared to two (3.5%) respondents who covered the subject in five or more class periods. One (1.8%) respondent did not answer this question. Table 23 outlined the data for each of the three areas discussed above.

Table 23. Respondents' time devoted to teaching woods/construction chemical safety, application, and disposal methods.

	Number of class periods devoted to teaching:					
	Proper woods/construction chemical safety		Proper woods/construction chemical application techniques		Proper woods/construction chemical disposal methods	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	15	26.3	10	17.5	25	43.9
1	22	38.6	25	43.9	25	43.9
2 to 4	16	28.1	18	31.6	4	7.0
5+	4	7.0	3	5.3	2	3.5
Non response	0	0.0	1	1.7	1	1.7
Total	30	100.0	62	100.0	62	100.0

Agronomy Laboratories

Nine respondents indicated the presence of an agronomy laboratory in their agricultural education program. The respondents for this section were instructed to identify all of the specific agronomic areas found within their laboratory. Table 24 showed that six (66.7%) respondents had a forage/hay operation, five (55.6%) grew

cereal grains, three (33.3%) grew specialty/oil crops and another three (33.3%) had fruit and/or vegetable operations.

Table 24. Type and frequency of agronomy programs.

Types of agronomy programs	Frequency	n	Percent
Forage/hay	6	9	66.7
Cereal grain	5	--	55.6
Specialty/oil crop	3	--	33.3
Fruit and/or vegetable	3	--	33.3
Other	0	--	0.0
Total	17	N/A	N/A

The nine respondents for this section were asked to quantify, in pounds, the pounds of agricultural chemicals present in their agronomy laboratory facilities. Survey results showed that fertilizer was the most prevalent chemical with 10,013 pounds (99.7%) of new chemical and one-half pound (0.1%) of used/open chemical found in the nine respondents' laboratories. Ranked second were herbicides with zero pounds of new chemical and 89.7 pounds (89.8%) of used chemical in respondents' laboratories. Completing the list was insecticides which accounted for 0.1% (8 pounds) of new chemical and 5.1% (5 pounds) of used/open insecticide as well as one pound (0.1%) of new fungicides present in the laboratories. Five pounds (5.1%) of used/open seed treat were reported while no new pounds were reported. Two pounds of rodenticides were reported while no used/open pounds were reported. No used/open pounds were reported of used/open fungicides as well as no new or used/open pounds of pesticides was

reported. Chemicals present in respondents' agronomy laboratories was found in Table 25.

Table 25. Pounds of chemicals that were present in respondents' agronomy laboratories.

Chemical	New weight	Percentage of total new chemicals found in the laboratory	Used/open weight	Percentage of total used/open chemicals found in the laboratory
Herbicides	0	0.0	88	89.7
Pesticides	0	0.0	0	0.0
Rodenticides	2	0.0	0	0.0
Insecticides	8	0.1	5	5.1
Fungicides	1	0.1	0	0.0
Fertilizer	10,013	99.8	0.5	0.1
Seed treat	0	0.0	5	5.1
Total	10,024	100.0	98.5	100.0

Respondents of this section were asked to disclose the length of time that they stored the reported used/open chemicals listed in Table 25 in their agronomy laboratory. Figure 14 illustrated the responses to this question. The majority of respondents stored used/open chemicals over one year. Three (33.3%) stored chemicals for at least one year, and one (11.1%) stored agronomy chemicals in their laboratory for over one year. Three (33.3%) respondents kept used/open chemicals no more than one week whereas no respondents kept the chemicals no more than one month. No respondents stored chemicals only one school semester. Two (22.2%) respondents to this section did not answer this question.

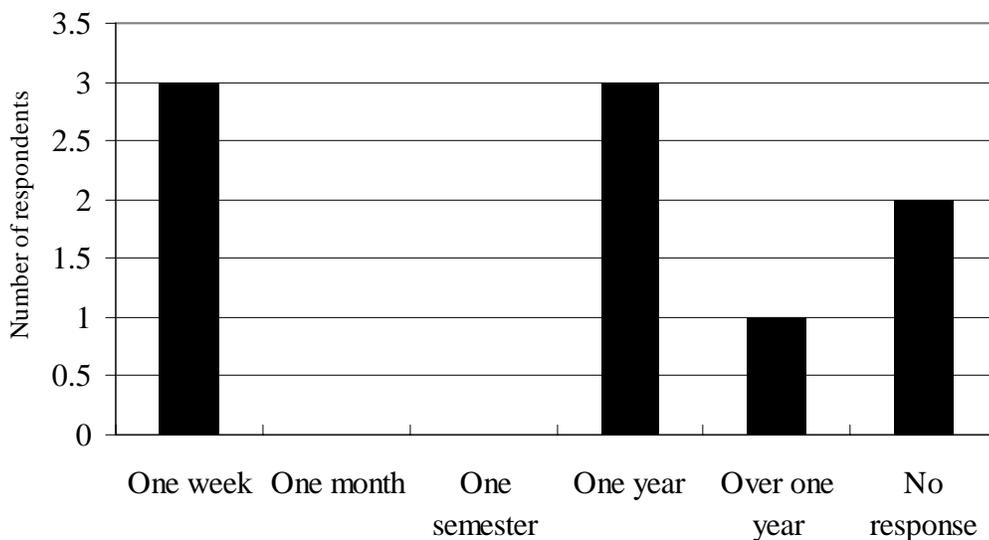


Figure 14. Length of time respondents stored used/open agronomy chemicals.

Most educators taught one to four class periods about the pollution prevention and environmental risk concerns related to agronomy laboratory topics noted in the survey. No respondents taught zero periods on agronomy chemical safety whereas five (55.6%) respondents devoted at least one period to the subject. Another four (44.4%) respondents spent two to four periods on chemical safety while no respondent devoted five or more class periods to the subject.

None of the respondents did not devote time to agronomy chemical application whereas 33.3% ($n=3$) of respondents spent at least one class period on the topic. Five (55.6%) respondents spent two to four class periods whereas one (11.1%) spent five or more class periods on agronomy chemical application.

In regard to agronomy chemical disposal techniques and methods, 77.8% ($n=7$) of respondents spent one class period on the subject. Whereas no respondents spent no class periods on chemical disposal techniques and methods. One (11.1%) respondent devoted two to four class periods to the topic while one (11.1%) respondent covered the subject in five or more class periods. Table 26 outlined the data for each of the three areas discussed above.

Table 26. Respondents' time devoted to teaching agronomy chemical safety, application and disposal.

	Number of class periods devoted to teaching:					
	Proper agronomy chemical safety		Proper agronomy chemical application techniques		Proper agronomy chemical disposal methods	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	0	0.0	0	0.0	0	0.0
1	5	55.6	3	33.3	7	77.8
2 to 4	4	44.4	5	55.6	1	11.1
5+	0	0.0	1	11.1	1	11.1
Total	9	100.0	9	100.0	9	100.0

Animal Husbandry Laboratories

Thirteen respondents indicated the presence of an animal husbandry laboratory in their agricultural education program. The respondents for this section were instructed to identify animal species found within their animal husbandry laboratory. Table 27 showed that eight (61.5%) had horse operations, seven (53.8%) had beef operations, seven (53.8%) had swine operations, six (46.2%) had sheep operations, five (38.5%)

grew fish, four (30.8%) had poultry operations, three (23.1%) had dairy operations and one (7.7%) had a miscellaneous operation categorized as other.

Table 27. Type and frequency of respondents' animal husbandry programs.

Types of animal programs	Frequency	n	Percent
Beef	7	13	53.8
Sheep	6	--	46.2
Swine	7	--	53.8
Dairy	3	--	23.1
Poultry	4	--	30.8
Horse	8	--	61.5
Fish	5	--	38.5
Other	1	--	7.7
Total	41		N/A

The 13 respondents for this section were asked to quantify, in cubic centimeters, the amount of liquid chemical present in their animal husbandry laboratories. Results showed that de-wormers were the most prevalent chemical with 20,671 cubic centimeters (cc) (78.7%) of new chemical and 17,034cc (57.5%) of used/open chemical found in the thirteen respondents' laboratories. Ranked second were antiseptics with 3,785cc (14.4%) of new chemical and 11,356cc (38.3%) of used/open chemical in respondents' laboratories. Vaccines accounted for 3.4% (900cc) of new chemical and 1.9% (560cc) of used/open vaccine as well as 900cc (3.4%) of new antibiotics present in the laboratories and 700cc (2.4%) of used/open antibiotic chemical present. No used volume was reported of new or used/open fungicides. Chemicals present in respondents' animal husbandry laboratories was reported in Table 28.

Table 28. Volume of chemical present in respondents' animal husbandry laboratories.

Chemical	New volume (cc)	Percentage of total new chemicals found in the laboratory	Used/open volume (cc)	Percentage of total used/open chemicals found in the laboratory
Vaccines	900	3.4	560	1.9
Antibiotics	900	3.4	700	2.4
De-wormers	20,671	78.7	17,034	57.5
Antiseptics	3,785	14.5	11,356	38.2
Fungicides	0	0.0	0	0.0
Total	26,256	100.0	29,650	100.0

Respondents were asked to list the methods they employed when disposing of needles, syringes, and associated animal husbandry supplies. Their responses were listed below.

1. Approved sharps container ($f = 5$)
2. No response ($f = 4$)
3. Don't use them
4. Dumpster
5. Placed syringes in garbage after students are gone for the day
6. Not used at school

Respondents in this section were also asked to list their methods of manure management generated by the animal in their laboratories. Their management methods were listed below.

1. Agronomy lab fertilizer ($f = 6$)

2. Compost
3. Confined manure generated indoors washed down drain
4. Few animals in large areas, no disposal problem
5. Hauled to local gardens
6. Swine manure goes in the city septic system, Cattle manure is spread on fields
7. Spread on local fields
8. Spread on school garden

Most educators spent five or more class periods teaching about pollution prevention and environmental risk concerns. Two (15.4%) respondents devoted at least one period to the subject. Another four (30.8%) respondents spent two to four periods on animal chemical safety whereas six (46.2%) respondents devoted five or more class periods to the subject. No respondents spent zero class periods teaching animal husbandry chemical safety whereas one (7.7%) respondent did not answer this question.

In regard to proper animal husbandry laboratory chemical application, none of the respondents devoted any time to the subject at all whereas 7.7% ($n=1$) of respondents spent at least one class period on the topic. Five (38.5%) respondents spent two to four class periods compared to six (46.2%) respondents who spent five or more class periods on animal husbandry chemical application. One (7.7%) respondent did not answer the question.

For animal husbandry chemical disposal techniques and methods, 15.4% ($n=2$) of respondents spent no teaching time on the subject. Five (38.5%) respondents spent at least one class periods on chemical disposal techniques and methods. Three (23.1%) respondents devoted two to four class periods to the topic whereas two (15.4%) respondents covered the subject in five or more class periods. One (7.7%) respondent did not answer the question. Table 29 outlined the data for each of the three areas discussed above.

Table 29. Length of time respondents devoted to teaching animal husbandry chemical safety, application and disposal.

	Number of class periods devoted to teaching:					
	Proper animal husbandry chemical safety		Proper animal husbandry chemical application techniques		Proper animal husbandry chemical disposal methods	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
0	0	0.0	0	0.0	0	0.0
1	1	11.1	1	11.1	5	55.6
2 to 4	1	11.1	1	11.1	1	11.1
5+	6	66.7	6	66.7	2	22.2
No response	1	11.1	1	11.1	1	11.1
Total	9	100.0	9	100.0	9	100.0

Additional Areas of Study

The researcher gathered demographic data from respondents in the interest of exploring the possibility of statistically significant relationships between various demographic factors and pollution prevention/waste management practices. The

following data factors were analyzed but yielded no statistically significant relationships.

List one included demographic factors as listed below.

1. FFA district representation
2. MHSA class size school
3. Age group distribution of respondents
4. Education level of respondents
5. Community population
6. Gender of respondents
7. Years of teaching experience
8. Recipient of pollution prevention training in college
9. Recipient of waste management training in college
10. Recipient of in-service pollution prevention training
11. Recipient of in-service waste management training

List two included respondents' data related to pollution prevention and waste management teaching practices, recycling habits and practices, and length of chemical storage. All factors were listed below.

1. Engines/automotive chemical length of storage time
2. Local recycling options for respondents
3. Distance in miles to nearest recycling center
4. Number of class periods spent teaching engines/automotive chemical safety

5. Number of class periods spent teaching engines/automotive chemical application
6. Number of class periods spent teaching engines/automotive chemical disposal
7. Metal/welding chemical length of storage time
8. Frequency of recycling scrap metal
9. Frequency of servicing welding/foundry ventilation system
10. Number of class periods spent teaching metals/welding chemical and gas safety
11. Number of class periods spent teaching metals/welding chemical and gas application
12. Number of class periods spent teaching metals/welding chemical and gas disposal
13. Greenhouse chemical length of storage time
14. Number of class periods spent teaching greenhouse chemical and fertilizer safety
15. Number of class periods spent teaching greenhouse chemical and fertilizer application
16. Number of class periods spent teaching greenhouse chemical and fertilizer disposal
17. Woods/construction chemical length of storage time
18. Frequency of recycling woods/construction materials

19. Number of periods spent teaching woods/construction chemical safety
20. Number of periods spent teaching woods/construction chemical application
21. Number of periods spent teaching woods/construction chemical disposal
22. Agronomy chemical length of storage time
23. Number of periods spent teaching agronomy chemical safety
24. Number of periods spent teaching agronomy chemical application
25. Number of periods spent teaching agronomy chemical disposal
26. Number of periods spent teaching animal husbandry chemical safety
27. Number of periods spent teaching animal husbandry chemical application
28. Number of periods spent teaching animal husbandry chemical disposal

All data in list one were compared against data in list two. As previously indicated, the only statistically significant findings were discovered when gender was analyzed with respondents' time devoted to teaching engines/automotive chemical safety, application, and disposal.

CHAPTER 5

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

The purpose of this study was to determine pollution awareness, practices, and levels of pollutants in Montana's secondary agricultural education programs. Data were collected and analyzed to determine educators' teaching habits and practices regarding pollution prevention and practices.

To complete the purpose of the study, the following objectives were identified.

1. Determine the levels of pollutants that existed in Montana secondary agricultural education programs;
2. Identify the level pollution prevention education that was taught in Montana secondary agricultural education programs;
3. Determine the existing barriers to implementing pollution prevention in Montana secondary agricultural education classrooms.

Conclusions

Based on the analysis of data, relationships within data, and written comments by survey respondents, the following conclusions were drawn:

1. Respondents most frequently utilized engine/automotive, metals/welding, and woods/construction laboratories. Least frequently used were

greenhouses, agronomy, and animal husbandry laboratories (Appendix J).

Used engine oil, open paint thinner, and open paint were the most prevalent chemicals found in respondents' teaching laboratories

(Appendix J). Comments indicated that some of these chemicals were disposed improperly.

2. In general, respondents did not teach, or only utilized one class period, to cover pollution and environmental subjects. The exception was in animal husbandry laboratories where respondents spent two or more class periods on this subject matter.
3. There was a statistically significant difference between female and male agricultural educators regarding amount of teaching time devoted to chemical safety, application, and disposal in their engines/automotive laboratories.
4. The lack of college-level education and in-service professional development devoted to pollution prevention and waste management for agricultural educators was identified as a barrier to desirable pollution prevention practices and waste management methods. Findings indicated that agricultural educators in Montana have an interest in becoming more educated in the areas of pollution prevention and waste management.

Implications

The data collected and written comments provided by respondents has allowed the researcher to make the following statements:

1. Montana's agricultural educators carry a weighted responsibility to practice and teach environmentally acceptable principles in their classrooms and laboratory settings. This brings cause to call for increased instructor education in pollution prevention and waste management in agricultural education.
2. Agricultural education laboratory stewardship embraces a continuum from student to administrator. Research findings from this study implied that all individuals who use agricultural education facilities consider the consequences of their actions regarding pollution prevention and waste management.
3. Research findings from this study may be relevant to other facilities on public school premises such as bus barns and workshops.
4. Data from this study showed that an excess of used/open chemicals exist in Montana's agricultural education programs. Appropriate government agencies may offer training and clean-up programs to help purge the state of potential chemical risks in agricultural education programs.

A responsibility exists for Montana's MAAE leadership and the state's agricultural education specialist to offer pollution prevention and waste management training.

Recommendations

Based on conclusions drawn from the findings the researcher made the following recommendations.

1. A specific educational program focusing on pollution prevention and waste management for agricultural educators should be developed, tested, and disseminated as quickly as possible. This integrated unit plan should address agricultural education waste management, pollution awareness, pollution prevention, and laboratory management. The integrated unit plan should include content on recycling and proper disposal of chemicals as well as proper chemical application and safety.
2. Due to a lack of educators who devoted teaching time to agricultural education laboratory chemical safety, application, and disposal, an integrated unit plan for agricultural educators to use should be developed. Students in agricultural education laboratories should be taught chemical safety, application, and disposal. Creating an integrated unit plan that applies to all agricultural educator laboratories could help increase student

awareness of best management practices for laboratory chemical safety, application, and disposal.

3. It is recommended that a grant proposal should be pursued through the EPA for clean-up funds. With the data provided in this study a proposal could be written specifying the amount of used/open chemical that needs to be cleaned up and properly disposed. Based on the respondents' comments some of the state's agricultural educators irresponsibly handled harmful chemical pollutants and could use guidance and direction to dispose of these chemicals.
4. Pollution prevention and waste management training should become an integral part of post-secondary certification for agricultural educators.

Recommendations for Further Study

1. Similar research should be conducted in other career and technical fields of secondary education to determine pollutant levels and waste chemicals present in those laboratory facilities.
2. It is recommended that a more in-depth look at the correlation between women and time devoted to teaching engines/automotive chemical safety, application, and disposal be explored.
3. A follow-up study targeting post-secondary institutions such as two-year technical schools, vocational colleges, and traditional four-year

institutions should be completed to add to the body of knowledge that exists in this area.

4. After in-service and dissemination of integrated unit plans the study should be replicated to determine if the in-service educational programs and curriculum implementation made a difference.
5. A review of current curriculum, unit plans, and lessons plans should take place to determine existing pollution prevention and waste management curriculum available to secondary agricultural educators.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects

960 Technology Blvd. Room 127
c/o Veterinary Molecular Biology
Montana State University
Bozeman, MT 59718
Telephone: 406-994-6783
FAX: 406-994-4303
E-mail: cherylj@montana.edu

Chair: Mark Quinn
406-994-5721
mquinn@montana.edu
Administrator:
Cheryl Johnson
406-994-6783
cherylj@montana.edu

MEMORANDUM

TO: Ben Meyer

FROM: Mark Quinn, Ph.D. Chair *Mark Quinn is*
Institutional Review Board for the Protection of Human Subjects

DATE: October 11, 2006

SUBJECT: *An Examination of Pollution Awareness, Prevention, and Best Practices in Montana Secondary Agriculture Education Programs*

The above research, described in your submission of October 10, 2006, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal Regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- (b)(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- (b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- (b)(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- (b)(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- (b)(5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- (b)(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

INITIAL SURVEY CONSENT LETTER


Division of Agricultural Education / Agricultural Operations Technology

109 Cheever Hall	Telephone	(406) 994-2132
P.O. Box 173740	Fax	(406) 994-6696
Bozeman, MT 59717-3740	Website	http://ag.montana.edu/ageducation

Thank you for agreeing to take part in this completely voluntary survey. The data collected from this survey will help the Montana State University Extension Housing and Environmental Health Program better meet the needs of the Montana secondary agricultural education community in terms of pollution prevention and environmental risk negotiation.

All information collected in this survey will be kept confidential and **cannot and will not** be compared or corroborated with the individual respondent.

Please sign your name below and indicate your school that you teach in. By signing this document you consent to filling out this survey honestly and completely. There is no foreseeable risk involved for either participants or non-participants.

Thank you,

Ben Meyer	Dr. Martin Frick	Dr. Michael Vogel
MSU Ag Ed Grad. Student	MSU Ag Ed Division Leader	MSU Extension P ₂ Program

APPENDIX C

SURVEY MAIL FOLLOW UP LETTER



Division of Agricultural Education / Agricultural Operations Technology

109 Cheever Hall	Telephone	(406) 994-2132
P.O. Box 173740	Fax	(406) 994-6696
Bozeman, MT 59717-3740	Website	http://ag.montana.edu/ageducation

November 13, 2006

Thank you for agreeing to take part in this completely voluntary survey. The data collected from this survey will help the Montana State University Extension Housing and Environmental Health Program better meet the needs of the Montana secondary agricultural education community in terms of pollution prevention and environmental risk negotiation.

All information collected in this survey will be kept confidential and **cannot and will not** be compared or corroborated with the individual respondent.

This survey is being collected by MSU agricultural education graduate student Assa Kante. In order to protect your anonymity, please use the enclosed envelope to return the surveys to:

Assa Kante
 109 Cheever Hall
 Ag Ed Department
 Montana State University
 Bozeman, MT 59717

Assa is an agricultural education graduate student from Bamako, Mali Africa. Assa does not personally know any of the Montana ag educators and therefore can safely serve as the initial collection person for your completed survey. This will help to ensure the utmost in discreetness and confidentiality of your responses.

Thank you,

Ben Meyer	Dr. Martin Frick	Dr. Michael Vogel
MSU Ag Ed Grad. Student	MSU Ag Ed Division Leader	MSU Extension P ₂ Program

APPENDIX D

SUBJECT CONSENT FORM



Division of Agricultural Education / Agricultural Operations Technology

109 Cheever Hall	Telephone	(406) 994-2132
P.O. Box 173740	Fax	(406) 994-6696
Bozeman, MT 59717-3740	Website	http://ag.montana.edu/ageducation

SUBJECT CONSENT FORM FOR PARTICIPATION IN HUMAN RESEARCH AT
MONTANA STATE UNIVERSITY

A study regarding pollution awareness, prevention, and best practices in Montana secondary agriculture education programs as perceived by Montana's agricultural educators.

The study is completely voluntary. If you agree to participate, your responses will be confidential. There is no personal benefit, consequence or cost for participation or for non-participation.

If you have questions regarding this research, the data collection or analysis process, or the plans for results dissemination, you may contact Dr. Martin Frick (phone 406.994.5773; email mfrick@montana.edu) or Ben Meyer (phone 406.994.5778; email bmeyer@metnet.mt.gov). If you have questions or concerns about your rights as a human subject involved in this research, you may contact Dr. Mark Quinn, Institutional Review Board Chairperson (phone 406.994.5721; email mquinn@montana.edu).

AUTHORIZATION: I have read the above and understand there are no personal benefits, consequences or costs associated with my participation in this study. I, _____ (*name of participant*), voluntarily agree to participate in this research. I understand that I may later refuse to participate, and that I may withdraw from the study at any time. I have received a copy of this consent form for my own records.

Signed: _____

Date: _____

APPENDIX E

SURVEY INSTRUMENT

**A Survey of Pollutants and Environmental Risk Factors in Montana
Secondary Agricultural Education Programs**

This survey is designed to ascertain possible pollutants in six key areas of your agricultural education program. The goal of the program is to provide local technical assistance and instruction associated with proper environmental risk handling, storage, and disposal.

Key areas included in this survey include: **Engine and automotive labs, Metals and welding labs, Greenhouse labs, Woods and Construction labs, Agronomy based farm labs, and Animal husbandry based farm labs.** If you do not have one or more of the key areas please skip those sections and move on. **In addition, please answer these survey questions as they pertain to your direct teaching assignment.** Thank you for your time and interest in filling out this survey.

All information gathered will remain confidential. This survey is **completely voluntary** and will help officials at Montana State University ascertain valuable information about pollutants and environmental risk factors in Montana's agricultural education programs. No data will be collated or corroborated with the individual respondent.



6. How many of the students you indicated in question 5 are exposed to any of the lab settings questioned in this survey; Engine and automotive labs, Metals and welding labs, Greenhouse labs, Woods and Construction labs, Agronomy based farm labs, and Animal husbandry based farm labs?
- _____
7. What grades of students do you instruct?
- 6-12
 - 7-12
 - 8-12
 - 9-12
 - Other _____
8. What size is your community, considering only the population of the town in which your school is located, according to the latest (2000) US Census data?
- 1-200 residents
 - 201-500
 - 501-1,000
 - 1,001-2,000
 - 2,001-4,000
 - 4,001-6,000
 - 6,000-10,000
 - 10,000 +
9. What is your gender?
- Female
 - Male
10. How many years of teaching experience (Ag Ed and other) do you have?
- 0-10
 - 11-20
 - 21-30
 - 31-40
 - 41+

Section I - General Information - Required Information

- In which FFA District does your program reside?
 - Big Muddy
 - Eastern
 - Glacier
 - Judith Basin
 - Southern
 - South Eastern
 - South Western
 - Western
- In what MHSA class size school do you teach?
 - AA
 - A
 - B
 - C
- What is your age?
 - 21-35
 - 36-50
 - 51-65
 - 65 +
- What is your level of education
 - Bachelors degree
 - Masters degree
 - Doctorate degree
- How many students (unduplicated) do you teach in agricultural education each day?

- Did you receive any pollution prevention training related to agricultural education facilities in college?
 - Yes
 - No
- Did you receive any waste management training related to agricultural education facilities in college?
 - Yes
 - No
- Have you ever received any in-service pollution prevention training?
 - Yes
 - No
- Have you ever received any in-service waste management training?
 - Yes
 - No
- Would you attend in-service/professional development training on pollution prevention and/or waste management if it were offered in the state of Montana? (select only one)
 - Yes, if it were offered through a MAAE conference at Summer Update
 - Yes, if it were at a site no more than two hours from my program
 - Yes, only if the training was free
 - Yes, only if the training was less than \$100
 - Yes, only if renewal credits were offered
 - No, I would not attend

Section II - Engine and Automotive Lab

Only complete if you have this type of facility in your program. If not, proceed to section III. Please remember that all of your answers are confidential and cannot/will not be corroborated with any identifying information.

16. How many gallons of the chemicals listed below are in or around your engines/automotive labs (approximate as necessary)?

New/Unopened	Used/Waste
<input type="radio"/> Oil _____	_____
<input type="radio"/> Transmission Fluid _____	_____
<input type="radio"/> Antifreeze _____	_____
<input type="radio"/> Refrigerants (R-134, Freon) _____	_____
<input type="radio"/> Brake Fluid _____	_____
<input type="radio"/> Diesel or Gasoline _____	_____
<input type="radio"/> Engine Cleaning Solvents _____	_____
<input type="radio"/> Other _____	_____

17. How long, on average, are used chemicals stored in and around your lab?

- One Week
- One Month
- One Semester
- One Year
- Over One Year

22. Does your engine and/or automotive lab work area have a spill containment area such as a sump, trapped drain, etc.?

- Yes
 - No
- a. If yes, how often do you have your sump and/or drain system professionally cleaned/pumped out?
- At least once per semester
 - At least once every school year
 - At least once every few years (three or more years)
 - I haven't had it cleaned since I've been teaching in my program

23. Which of the following solid waste items do you accumulate in your automotive lab?

- Used Batteries
- Used Oil/Fuel Filters
- Used Tires
- Air Conditioning Cores
- Other _____

24. Please comment on how you dispose of wastes generated in your engine/automotive lab. For example what are your disposal methods, uses of recycling or approved disposal options, etc?

25. How many class periods do you spend teaching automotive chemical and fluids safety to your students who utilize your automotive/engines lab?

- 0
- 1
- 2-4
- 5 +

18. Where are MSDS (material safety data sheets) located in relation to your stored chemicals in your automotive/engines lab?

- Within 10 feet of the stored chemicals
- In a common area of the lab, but over 10 feet away from the stored chemicals
- In an office or storage space associated with your lab
- Hard to say where they're located

19. Are all stored fluids (sealed or unsealed) stored in their original containers?

- Yes
- No

20. Do any recycling/disposal options exist in your community for the fluids mention in question 16?

- Yes
- No

a. If you answered yes to question 20, which fluid(s) can be recycled or disposed of in your community?

b. If you answered yes to question 20, do you use the recycling or disposal options?

- Yes
- No

21. How many miles away from your program is the nearest recycling center for petroleum based products?

- a. 0-1 Mile
- b. 1-5 Miles
- c. 6-20 Miles
- d. 21-50 Miles
- e. Over 51 Miles

26. How many class periods do you spend teaching proper automotive fluid application and usage to your students who utilize your automotive/engines lab?

- 0
- 1
- 2-4
- 5 +

27. How many class periods do you spend teaching proper automotive fluid disposal to your students who utilize your automotive/engines lab?

- 0
- 1
- 2-4
- 5 +

Section III - Metals and Welding Lab

Only complete if you have this type of facility in your program. If not, proceed to section IV. Please remember that all of your answers are confidential and cannot/will not be corroborated with any identifying information.

28. How many gallons of the chemicals listed below are in or around your metals/welding labs (approximate as necessary)?

New/Unopened	Open Containers
<input type="radio"/> Cutting Oil _____	_____
<input type="radio"/> Paint Thinner _____	_____
<input type="radio"/> Paint Stripper/Remover _____	_____
<input type="radio"/> Foundry Chemicals _____	_____

29. How long, on average, are **open/unsealed** chemicals stored in and around your metals and welding lab?
- One Week
 - One Month
 - One Semester
 - One Year
 - Over One Year
30. Where are MSDS (material safety data sheets) located in relation to your stored chemicals in your automotive/engines lab?
- Within 10 feet of the stored chemicals
 - In a common area of the lab, but over 10 feet away from the stored chemicals
 - In an office or storage space associated with your lab
 - Hard to say where they're located
31. When do you test gas cylinders and hoses for leaks?
- Never
 - Yearly
 - Quarterly
 - Monthly
 - Weekly
32. How often do you recycle scrap metal generated by your program?
- Every month
 - Every semester
 - Each school year
 - Never, it accumulates because I will have a use for it someday
33. Please comment on how you dispose of metal dust and shavings in your lab.
- _____
34. Do you have a fluid cooled metal bandsaw in your lab?
- Yes
 - No

Section IV – Greenhouse Laboratories

Only complete if you have this type of facility in your program. If not, proceed to section V. Please remember that all of your answers are confidential and cannot/will not be corroborated with any identifying information.

39. How many gallons or pounds (please label) of the chemicals listed below are in or around your greenhouse labs (approximate as necessary)?

New/Unopened	Open Containers
<input type="radio"/> Fertilizers _____	_____
<input type="radio"/> Selective Herbicides _____	_____
<input type="radio"/> Non Selective Herbicides _____	_____
<input type="radio"/> Insecticides _____	_____
<input type="radio"/> Fungicides _____	_____

40. How long, on average, are **open/unsealed** chemicals stored in and around your greenhouse lab?
- One Week
 - One Month
 - One Semester
 - One Year
 - Over One Year
41. Where are MSDS (material safety data sheets) located in relation to your stored chemicals in your greenhouse lab?
- Within 10 feet of the stored chemicals
 - In a common area of the lab, but over 10 feet away from the stored chemicals
 - In an office or storage space associated with your lab
 - Hard to say where they're located

- a. If you answered yes to question 34, how do you dispose of your metal bandsaw fluid?
- _____

35. Do you have an air ventilation system for your welding booths and/or foundry area?
- Yes
 - No
- a. If you answered yes to question 34, how often do you have your ventilation system professionally checked?
- Every Few Years
 - Yearly or More Often
 - Never
36. How many class periods do you spend teaching welding/metals chemical and gas safety to your students who utilize your metals lab?
- 0
 - 1
 - 2-4
 - 5 +
37. How many class periods do you spend teaching proper gas and chemical application to your students who utilize your metals lab?
- 0
 - 1
 - 2-4
 - 5 +
38. How many class periods do you spend teaching scrap metal re-use/recycling and proper disposal to your students who utilize your metals lab?
- 0
 - 1
 - 2-4
 - 5 +
42. Are your greenhouse chemicals stored in a unit that is impermeable to water?
- Yes
 - No
43. Are all stored chemicals in their original containers?
- Yes
 - No
44. Please describe the water drainage system for your greenhouse.
- _____
- _____
45. How many class periods do you spend teaching greenhouse chemicals and fertilizer safety to your students who utilize your greenhouse lab?
- 0
 - 1
 - 2-4
 - 5 +
46. How many class periods do you spend teaching greenhouse chemicals and fertilizer application rates to your students who utilize your greenhouse lab?
- 0
 - 1
 - 2-4
 - 5 +
47. How many class periods do you spend teaching proper greenhouse chemicals and fertilizer disposal techniques to your students who utilize your greenhouse lab?
- 0
 - 1
 - 2-4
 - 5 +

Section V – Woods and Construction Laboratories

Only complete if you have this type of facility in your program. If not, proceed to section VI. Please remember that all of your answers are confidential and cannot/will not be corroborated with any identifying information.

48. How many gallons of the chemicals listed below are in or around your woods/construction labs (approximate as necessary)?
- | New/Unopened | Open Containers |
|--|-----------------|
| <input type="radio"/> Paint _____ | _____ |
| <input type="radio"/> Solvents _____ | _____ |
| <input type="radio"/> Stain _____ | _____ |
| <input type="radio"/> Glue and Adhesives _____ | _____ |
49. How long, on average, are **open/unsealed** chemicals stored in and around your woods/construction lab?
- One Week
 - One Month
 - One Semester
 - One Year
 - Over One Year
50. Where are MSDS (material safety data sheets) located in relation to your stored chemicals in your woods/construction lab?
- Within 10 feet of the stored chemicals
 - In a common area of the lab, but over 10 feet away from the stored chemicals
 - In an office or storage space associated with your lab
 - Hard to say where they're located
51. Are all stored chemicals in their original containers?
- Yes
 - No

52. Please describe the method(s) you use to dispose of leftover paint, stain, and solvents after a project is finished.
- _____
- _____

53. Do you recycle any chemical materials associated with your woods/construction lab?
- Yes
 - No
54. How many class periods do you spend teaching woodworking chemical and solvent safety to your students who utilize your woods/construction lab?
- 0
 - 1
 - 2-4
 - 5 +
55. How many class periods do you spend teaching woodworking chemical and solvent application to your students who utilize your woods/construction lab?
- 0
 - 1
 - 2-4
 - 5 +
56. How many class periods do you spend teaching woodworking chemical and materials recycling and disposal to your students who utilize your woods/construction lab?
- 0
 - 1
 - 2-4
 - 5 +

Section VI – Agronomy Based Farm Laboratories

Only complete if you have this type of facility in your program. If not, proceed to section VII. Please remember that all of your answers are confidential and cannot/will not be corroborated with any identifying information.

57. What type of agronomy laboratory does your program have? (select all that apply)
- Forage/Hay
 - Cereal Grain
 - Specialty/Oil Crops
 - Fruit and/or Vegetable
 - Other _____
58. How many gallons or pounds (please label) of the chemicals listed below are in or around your farm agronomy labs (approximate as necessary)?
- | New/Unopened | Open Containers |
|--|-----------------|
| <input type="radio"/> Herbicides _____ | _____ |
| <input type="radio"/> Pesticides _____ | _____ |
| <input type="radio"/> Rodenticides _____ | _____ |
| <input type="radio"/> Insecticides _____ | _____ |
| <input type="radio"/> Fungicides _____ | _____ |
| <input type="radio"/> Fertilizers _____ | _____ |
| <input type="radio"/> Seed Treat _____ | _____ |

59. How long, on average, are **open/unsealed** chemicals stored in and around your agronomy lab?
- One Week
 - One Month
 - One Semester
 - One Year
 - Over One Year
60. Where are MSDS (material safety data sheets) located in relation to your stored chemicals in your agronomy lab?
- Within 10 feet of the stored chemicals
 - In a common area of the lab, but over 10 feet away from the stored chemicals
 - In an office or storage space associated with your lab
 - Hard to say where they're located
61. Is any part of your lab program near or adjacent to a source of open water?
- Yes
 - No
62. How many class periods do you spend teaching agronomy chemical safety to your students who utilize your agronomy farm lab?
- 0
 - 1
 - 2-4
 - 5 +
63. How many class periods do you spend teaching agronomy chemical application to your students who utilize your agronomy farm lab?
- 0
 - 1
 - 2-4
 - 5 +

64. How many class periods do you spend teaching proper agronomy chemical disposal to your students who utilize your agronomy farm lab?
- 0
 - 1
 - 2-4
 - 5 +

Section VII – Animal Husbandry Based Farm Labs

Only complete if you have this type of facility in your program. Please remember that all of your answers are confidential and cannot/will not be corroborated with any identifying information.

65. What type of animal husbandry laboratory does your program have? (select all that apply)
- Beef
 - Sheep
 - Swine
 - Dairy
 - Poultry
 - Horse
 - Fish
 - Other _____
66. How many head of each species does your lab maintain on average each school year?
- Beef _____
 - Sheep _____
 - Swine _____
 - Dairy _____
 - Poultry _____
 - Horse _____
 - Fish _____
 - Other _____

72. How many class periods do you spend teaching animal health product safety to your students who utilize your animal husbandry farm lab?
- 0
 - 1
 - 2-4
 - 5 +

73. How many class periods do you spend teaching proper animal health product application to your students who utilize your animal husbandry farm lab?
- 0
 - 1
 - 2-4
 - 5 +

74. How many class periods do you spend teaching proper animal health product disposal to your students who utilize your animal husbandry farm lab?
- 0
 - 1
 - 2-4
 - 5 +

75. Please describe the method(s) you use to manage manure in your animal husbandry lab setting.
- _____
- _____

67. How many ounces or CCs (please label) of the chemicals listed below are in or around your animal husbandry labs (approximate as necessary)?

New/Unopened	Open Containers
<input type="radio"/> Vaccines _____	_____
<input type="radio"/> Antibiotics _____	_____
<input type="radio"/> De-wormers _____	_____
<input type="radio"/> Antiseptics _____	_____
<input type="radio"/> Fungicides _____	_____

68. Where are MSDS (material safety data sheets) located in relation to your stored chemicals in your animal husbandry lab?
- Within 10 feet of the stored chemicals
 - In a common area of the lab, but over 10 feet away from the stored chemicals
 - In an office or storage space associated with your lab
 - Hard to say where they're located

69. Please describe how you dispose of used needles, syringes, and vaccine/antibiotic bottles in your lab.
- _____

70. Is any part of your lab program near or adjacent to a source of open water?
- Yes
 - No

71. Are any of your animals held in standard confinement areas? If yes, which species and how many head per year.
- Yes
 - No
- _____

Additional Questions

76. Do you have any comments regarding this survey?

77. Do you have any comments regarding pollution prevention education?

78. Is there an additional area(s) of pollution prevention or environmental risk that affects your program that this survey doesn't cover?

Thank you for your participation in this research project. Your input is greatly appreciated.

APPENDIX F

PILOT SURVEY LETTER



Division of Agricultural Education / Agricultural Operations Technology

109 Cheever Hall	Telephone	(406) 994-2132
P.O. Box 173740	Fax	(406) 994-6696
Bozeman, MT 59717-3740	Website	http://ag.montana.edu/ageducation

October 9, 2006

To: Beau Anderson, Williston Community College, Williston, ND
 Brian Combes, South HS, Bakersfield, CA
 Rick Cotta, Tehachapi HS, Tehachapi, CA
 Chris Dixson, North HS, Bakersfield, CA
 Albert Graham, Lindsay HS, Lindsay, CA
 Joia Jones, Ridgeview HS, Bakersfield, CA
 Brian Kantner, Kern Valley HS, Lake Isabella, CA
 Emily Keverline, Kern Valley HS, Lake Isabella, CA
 Joel Lamer, Carrington HS, Carrington, ND
 Ralph Mendes, Foothills HS, Bakersfield, CA
 John Meyer, Kern Valley HS, Lake Isabella, CA
 Roger Riley, Bakersfield Regional Occupations Center, Bakersfield, CA
 Dan Stave, Leeds HS, Leeds, ND
 Rick Vanett, Rugby HS, Rugby, ND
 Gary Wald, Maddock HS, Maddock, ND

Thank you for agreeing to participate in this pilot survey for my masters thesis project. Please answer the questionnaire as it pertains to your ag ed program. If you don't have one of the key areas please skip that section. Also skip questions 1-16 as they pertain directly to Montana respondents.

Please comment on the survey's readability and your ability to understand the questions. This will help me in creating a better survey tool for my main survey group in Montana.

Thank you for agreeing to complete this survey in such a tight time table. Please complete ASAP and return it in the pre-paid envelope that is enclosed.

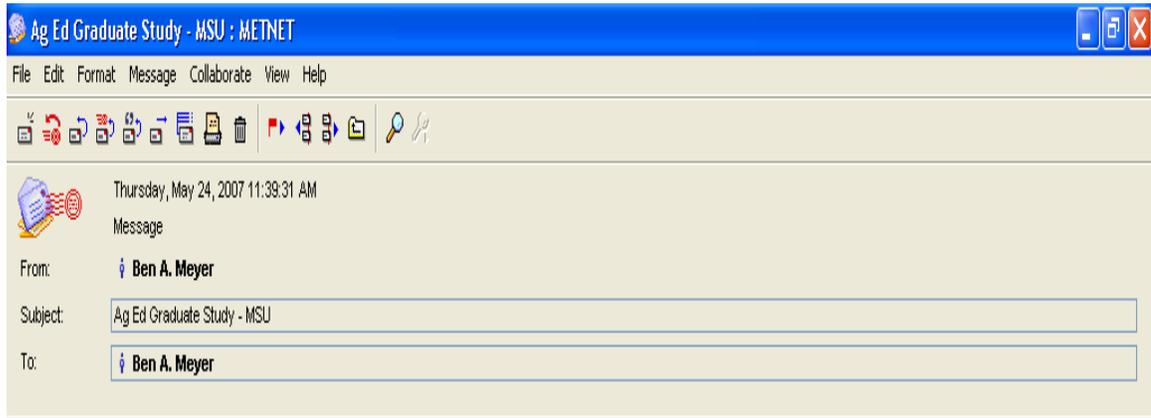
Thanks again for your help in my project.

Sincerely,

Ben Meyer
 Montana State University
 Agricultural Education
 Graduate Student

APPENDIX G

LATE RESPONSE ELECTRONIC COMMUNICATION



Just a quick reminder to please fill out and return the pollution and environmental risk survey that you received last month from MSU. To all the educators that have submitted their completed survey a big thank you. I'm still looking for over 20 surveys to be submitted to MSU. As always, if you do not wish to participate please send me an email indicating so.

Remember all of your answers are confidential and no identifying information is being collected in conjunction with this survey. Also please be sure to use the envelope that is included in your survey to resubmit to MSU. Assa Kante, graduate student from Africa, will be collecting the surveys and discarding the envelopes to ensure that your answers can not be corroborated with your postage cancellation or return address.

Thank you again for your participation in this study and efforts to improve Montana ag ed.

Ben Meyer
406-994-5778

APPENDIX H

SURVEY COMMENTS

Additional comments regarding the survey – question 75. Do you have any comments regarding this survey?

Are there any federal and state laws we need to be aware of?

Need more education just like 100 other issues in ag ed.

Education should start first with the administration then the teachers and other adults.

Needs to be taught along with hazards, laws, and damages to the environment.

Don't use this survey against me. I answered honestly and with truth.

The challenge is getting people to accept the responsibility of pollution prevention.

Prevention and responsibility don't fit in our society or personal ethics very well.

Needs to be done, and we as teachers need to be paid accordingly for handling this stuff.

I could use a lot more training and methods for disposal techniques.

Need more training.

Too bad the state educational system doesn't mandate recycling education and practices. How else will society learn?

Need more of it in and out of school.

I would like to know more

Taking this survey makes me realize just how little pollution prevention training and education I've received.

I would be interested in training if it were offered a reasonable difference from my school.

Need to be made aware of current updates.

Needs to be better developed.

Very different depending on the situation.

What about air pollution?

More is necessary.

Need more education.

Are there any good teaching materials available about waste disposal?

Need a resources for the areas covered in this survey.

Additional comments regarding pollution prevention education – question 76. Do you have any comments regarding pollution prevention education?

I am curious what everyone else does. Hopefully, this data will be shared.

Survey targets things that need to be changes but there isn't time or money to do them.

Too many schools have no facilities to manage waste.

Need option for less of than one gallon in survey choices.

We don't have the proper facilities to dispose of products.

We only purchase chemical that is needed and use them until they are gone. Your time frame questions are not applicable to us.

What recycling options might be available in urban areas?

Good things to ask as they are current issues!

Got me to thinking, thanks.

Keep results confidential.

Thought provoking.

Additional areas of pollution prevention or environmental risk that were not ask about in the survey – question 77. Is there any additional area(s) of pollution prevention or environmental risk that affects your program that this survey doesn't cover?

Maybe a little more on air quality and noise pollution for health reasons of the instructors around it on a continuous basis.

Education for dust collection in woods shop.

Ventilation of welding and dust fumes, Computer and e-waste, Ni batteries.

Welding smoke, paint and solvents are also risks in our school.

Air quality.

Air quality - combustion of metals and byproducts of welding and cutting processes.

Biology/chemistry labs and art departments.

We need some in-service on this.

Chemical disposal in science labs?

Vehicle emissions in the shop. Wood dust with not central collection system.

Floor sumps.

APPENDIX I

MONTANA AGRICULTURAL EDUCATION DIRECTORY FALL 2006

Montana Agricultural Education Directory - 2006-07

First	Last	School	Address	City	Zip	Phone	Email
BILL	JIMMERSON	State FFA Advisor	P O BOX 172855	BOZEMAN MT	59717	994-7050	bjimmer@mt.gov
RAYLEE	ST ONCE	FFA Foundation Director	502 SOUTH 19th, SUITE 110	BOZEMAN MT	59718	562-4118	ffafoundation@montanaffa.org
BRAD	KING	AgEd Specialist	P O BOX 202501	HELENA MT	59620	444-4451	brking2@mt.gov
DR MARTY	FRICK	AgEd/AOT Dept - MSU	AG ED & AOT 118 CHEEVER HALL	BOZEMAN MT	59717	994-5773	mfri@montana.edu
DR CARL	IGO	AgEd/AOT Dept - MSU	AG ED & AOT 118 CHEEVER HALL	BOZEMAN MT	59717	994-3693	cigo@montana.edu
		AgEd/AOT Dept - MSU	AG ED & AOT 118 CHEEVER HALL	BOZEMAN MT	59717	994-5776	
First	Last	School	Address	City	Zip	Phone	Email
TIM	ZUMBRUN	ABSAROKEE H S	327 S WOODARD AVE	ABSAROKEE MT	59001	328-4593	zumbrun@absarokee.k12.mt.us
ANN	RONNING	BAINVILLE H S	P O BOX 177	BAINVILLE MT	59212	769-2321	aronning@metnet.mt.gov
SCOTT	RIEGER	BAKER H S	P O BOX 659	BAKER MT	59313	778-3329	srieger@metnet.mt.gov
LAYNE	TAYLOR	BEAVERHEAD CO H S	104 NORTH PACIFIC	DILLON MT	59725	683-2361	layne@bchs.mt.gov
ROBERT	YATES	BELFRY H S	PO BOX 210	BELFRY MT	59008	664-3319	ryates@metnet.mt.gov
LORI	HOPPE	BELGRADE H S	303 N HOFFMAN	BELGRADE MT	59714	388-6682	hoppe@belgrade.k12.mt.us
JOE	ROBERTSON	BIG SANDY H S	P O BOX 570	BIG SANDY MT	59520	378-2502	robertson@metnet.mt.gov
GENE	MC CLURE	BIG SKY H S	3100 SOUTH AVE WEST	MISSOULA MT	59804	728-7095	mcclure@miss.k12.mt.us
STEVE	VERNIER	BIG SKY H S	3100 SOUTH AVE WEST	MISSOULA MT	59801	728-2401	vernier@metnet.mt.gov
RUSSELL	CLARK	BILLINGS CAREER CENTER	3723 CENTRAL AVE	BILLINGS MT	59102	685-3090	clarkr@billings.k12.mt.us
MARVIN	FORQUER	BILLINGS CAREER CENTER	3723 CENTRAL AVE	BILLINGS MT	59102	685-3090	forquer@billings.k12.mt.us
OLE	OLSEN	BRIDGER H S	429 WEST PARK AVE	BRIDGER MT	59014	662-3533	ol_olson@bridger.k12.mt.us
JESSICA	SHARPSTER	BROWNING H S	P O BOX 809	BROWNING MT	59417	338-2745	jessical@bchs.k12.mt.us
COURTNEY	HART	CARTER CO H S	P O BOX 458	EKALAKA MT	59324	775-8767	courtney_hart@hotmail.com
FRANK	LA LIBERTY	CASCADE H S	PO BOX 529	CASCADE MT	59421	468-2267	frankliberty@cascade.k12.mt.us
ERIC	TILLEMANN	CASCADE H S	PO BOX 529	CASCADE MT	59421	468-2267	etillemann@cascade.k12.mt.us
ROBIN	ALLEN	CHINOOK H S	P O BOX 1059	CHINOOK MT	59523	357-2236	robinok_fra@hotmail.com
MILFORD	WEARLEY	CHOTEAU H S	204 SEVENTH AVENUE NW	CHOTEAU MT	59422	466-5303	mwearley@metnet.mt.gov
JEWEL	DAVENPORT	COLSTRIP H S	P O BOX 159	COLSTRIP MT	59323	748-4699	jdavenport@colstrip.k12.mt.us
DANIEL	MILLER	COLUMBUS H S	433 3RD ST NORTH	COLUMBUS MT	59019	322-5373	millerd@columbus.k12.mt.us
JOYLYNN	KAUFFMAN	CONRAD H S	215 SOUTH MARYLAND	CONRAD MT	59425	278-3285	jkauffman@metnet.mt.gov
FRANK	AKERS	CULBERTSON H S	P O BOX 459	CULBERTSON MT	59219	787-6241	akersf@metnet.mt.gov
CARLA	LELIGDOWICZ	CUSTER H S	P O BOX 69	CUSTER MT	59024	856-4117	leligdowicz@metnet.mt.gov
JIM	BOTT	CUSTER CO H S	20 SOUTH CENTER AVE	MILES CITY MT	59301	234-4920	botjim@misscity.k12.mt.us
LISA	JOHNSON	DENTON H S	P O BOX 1048	DENTON MT	59430	567-2270	ljohns@hdmall.com
BRENT	HITCHCOCK	DUTTON H S	101 2ND STREET NE	DUTTON MT	59433	476-3424	poachhitch64@hotmail.com
BRIAN	BEDORD	FAIRFIELD H S	P O BOX 399	FAIRFIELD MT	59436	467-2528	bedord66@yahoo.com
JAMES	FINK	FAIRVIEW H S	P O BOX 467	FAIRVIEW MT	59221	742-5265	jmfink@fairview.k12.mt.us
WILL	HUMBER	FERGUS H S	201 CASINO CREEK DRIVE	LEWISTOWN MT	59457	538-2321	whumber@metnet.mt.gov
JUSTIN	HEUPEL	FLATHEAD H S	644 FOURTH AVE WEST	KALISPELL MT	59901	751-3950	jstjn_heupel@metnet.mt.gov
CLARK	KRANTZ	FLATHEAD H S	644 FOURTH AVE WEST	KALISPELL MT	59901	751-3950	krantz@ssd.k12.mt.us
BRIAN	BAY	FLATHEAD H S	644 FOURTH AVE WEST	KALISPELL MT	59901	751-3950	bayb@ssd.k12.mt.us
GEORGE	SIMMONS	FORSYTH H S	BOX 319	FORSYTH MT	59327	346-2796	gsimmons@forsyth.k12.mt.us
RICHARD	GREWELL	FROMBERG H S	P O BOX 189	FROMBERG MT	59029	668-7315	rgrewell@metnet.mt.gov
SEELY	DANIELS	GEYSER H S	PO BOX 70	GEYSER MT	59447	735-4366	sdaniels@metnet.mt.gov
TED	FULGHAM	HARDIN H S	702 N TERRY STREET	HARDIN MT	59035	666-6300	fulgham83@hotmail.com
ROD	DONAHUE	HARLEM H S	P O BOX 339	HARLEM MT	59526	353-2287	roddonahue@hs.k12.mt.us
GARY	OLSEN	HARLOWTON H S	304 DIVISION AVE	HARLOWTON MT	59036	632-4324	ggolse@mt-rtc.net
KAY	FIELD	HINSDALE H S	P O BOX 398	HINSDALE MT	59241	364-2314	kfield@metnet.mt.gov
SETH	WHITNEY	HOBBSON H S	P O BOX 410	HOBBSON MT	59452	423-5483	swhitney@metnet.mt.gov
MIKE	CAPRA	HUNTLEY PROJECT H S	1477 ASH STREET	WORDEN MT	59088	967-2540	mcapra@huntley.k12.mt.us
JAMIE	NELSON	HUNTLEY PROJECT H S	1477 ASH STREET	WORDEN MT	59088	967-2540	jnelson@huntley.k12.mt.us
JO ANNA	KOTAR	HYSHAM H S	P O BOX 272	HYSHAM MT	59038	342-5237	jkotar@metnet.mt.gov
CHAD	MASSAR	JOLIET H S	P O BOX 590	JOLIET MT	59041	962-3541	cmassar@metnet.mt.gov
TOM	FAULKNER	JUDITH GAP H S	P O BOX 67	JUDITH GAP MT	59453	473-2211	tfaulkner@metnet.mt.gov
TRISH	NEUMANN	LAMBERT H S	PO BOX 260	LAMBERT MT	59243	774-3333	trneumann@metnet.mt.gov
SHERRI	ROBERTS	LAME DEER H S	WEST BOUNDARY ST.	LAME DEER MT	59043	477-8900	sroberts@metnet.mt.gov
LARRY	HAY	LAUREL H S	203 EAST EIGHTH	LAUREL MT	59044	628-7911	larry_hay@laurel.k12.mt.us
SHELIA	DAUM	LAVINA H S	P O BOX 290	LAVINA MT	59048	636-2761	sdaum@metnet.mt.gov
BOB	SCHNEEKLOTH	LODGE GRASS H S	P O BOX 810	LODGE GRASS MT	59050	639-2385	bschneekloth@metnet.mt.gov
CHRIS	BERGNER	MALTA H S	BOX 670	MALTA MT	59538	654-2002	cbergner@metnet.mt.gov
AUBREY	ENGBERG	MEDICINE LAKE H S	P O BOX 265	MEDICINE LAKE MT	59247	789-2211	aengberg@metnet.mt.gov
CHRISTINE	LOCKE	MELSTONE H S	BOX 97	MELSTONE MT	59054	358-2352	clocke@metnet.mt.gov
TOM	ZUHOOSKI	MOORE H S	599 HIGHLAND AVE	MOORE MT	59464	374-2231	tzuhoski@mtinbound.net
JOHN	JOHNSON	OPHEIM H S	P O BOX 108	OPHEIM MT	59250	762-3213	johanson@metnet.mt.gov
LEE	NELSON	OPHEIM H S	P O BOX 108	OPHEIM MT	59250	762-3213	nelson2@opheimvillages.org
KARI	HANSON	PARK CITY H S	P O BOX 273	PARK CITY MT	59063	633-2350	khanson@metnet.mt.gov
KEVIN	FOCHS	PARK H S	102 VIEW VISTA	LIVINGSTON MT	59047	222-0448	parkefos@mcn.net
HEIDI	MAHLER	PEERLESS H S	P O BOX 475	PEERLESS MT	59253	893-4377	hmahler@metnet.mt.gov
LAURA	MOORE	PLENTY COUPS H S	PO BOX 229	PRYOR MT	59066	259-7924	moore@pryor.k12.mt.us
CASEY	OSKSA	PLENTYWOOD H S	100 EAST LAUREL AVE	PLENTYWOOD MT	59254	765-1803	osksa@metnet.mt.gov
GREG	GUNDERSON	PLEVNA H S	P O BOX 158	PLEVNA MT	59344	772-5666	ggund@midrivers.com
MARSHALL	WILLIAMS	POWDER RIVER DIST H S	500 NORTH TRAUTMAM	BROADUS MT	59317	436-2658	marshalli@broadus.net
BILL	LOMBARDI	POWELL CO H S	789 MISSOURI AVE	DEER LODGE MT	59722	846-2757	billombardi@bchs.d1.k12.mt.us
SCOTT	BLAIN	RED LODGE H S	P O BOX 1090	RED LODGE MT	59068	446-1903	sblain@metnet.mt.gov
CRYSTAL	HEATH	RICHEY H S	P O BOX 60	RICHEY MT	59259	773-5523	richevis@midrivers.com
JOHN	HARWOOD	ROBERTS H S	106 MAPLE	ROBERTS MT	59070	445-2421	harwood@metnet.mt.gov
KIM	GALLAGHER	RONAN H S	P O DRAWER R	RONAN MT	59864	676-3390	kgallagher@metnet.mt.gov
VERLIN	MILLER	ROSEBUD H S	P O BOX 38	ROSEBUD MT	59347	347-5353	verberc57@midrivers.com
STEVE	CHREST	ROY H S	P O BOX 9	ROY MT	59471	464-2511	schrest@yahoo.com
JEFF	HOLMES	RYEGATE H S	BOX 129	RYEGATE MT	59074	568-2211	holmes@metnet.mt.gov
LULA RAE	OMDAHL	SHELBY H S	1001 VALLEY	SHELBY MT	59474	424-8910	lulomghu@shelby.k12.mt.us
STACY	DIETZ	SHEPHERD H S	P O BOX 8	SHEPHERD MT	59079	373-5300	sdietz@shepherd.k12.mt.us
WALTER	DEAN	SHERIDAN H S	P O BOX 586	SHERIDAN MT	59749	842-5401	wdean@metnet.mt.gov
JIM	ROSE	SHIELDS VALLEY H S	P O BOX 40	CLYDE PARK MT	59018	686-4621	sufrta@hotmail.com
GARY	SCHAFF	SIDNEY H S	1012 FOURTH AVE SE	SIDNEY MT	59270	433-2330	gschaff@metnet.mt.gov
JOHN	MC CRAY	STANFORD H S	P O BOX 506	STANFORD MT	59479	566-2265	mccrayjohn@hotmail.com
RAMEY	LUNCEFORD	STEVENSVILLE H S	300 PARK STREET	STEVENSVILLE MT	59870	777-5481	rlunceford@stevensville.k12.edu
WILLIE	LUBANCH	SWEET GRASS CO H S	P O BOX 886	BIG TIMBER MT	59011	932-5993	wilubahn@metnet.mt.gov
GARY	MATTHEIS	SWEET GRASS CO H S	P O BOX 886	BIG TIMBER MT	59011	932-5993	gmattheis@metnet.mt.gov
JOHN	SCHNEIDER	TURNER H S	P O BOX 40	TURNER MT	59542	379-2219	jschneider@metnet.mt.gov
BUTCH	ROBERTS	WIBAUX H S	ROUTE 1 BOX 2073	WIBAUX MT	59353	796-2474	broberts@metnet.mt.gov
OSCAR	CANTU	WINIFRED H S	BOX 109	WINIFRED MT	59489	462-5420	ocant@winifred.k12.mt.us
PETE	RISING	WOLF POINT H S	213 SIXTH AVE SOUTH	WOLF POINT MT	59201	653-1200	prising@wolfpoint.k12.mt.us
DUWAYNE	WILSON	WOLF POINT H S	213 SIXTH AVE SOUTH	WOLF POINT MT	59201	653-1200	dwilson@namontel.net

APPENDIX J

SUMMATIVE CHEMICAL INVENTORY

Respondents' chemical inventory (gallons)		
Engines/automotive laboratories	New volume	Used/open volume
Oil	247.50	960.00
Transmission fluid	52.25	56.00
Antifreeze	72.00	102.00
Refrigerants	0.00	0.00
Brake fluid	20.25	6.75
Diesel/Gasoline	187.00	95.00
Engine cleaning solvents	440.50	165.00
Total laboratory volume	1,019.00	1,385.75
Metals/welding laboratories	New volume	Used/open volume
Cutting oil	30.63	39.13
Paint thinner	62.75	56.50
Paint stripper	18.75	20.50
Foundry chemicals	0.00	1.50
Total laboratory volume	112.13	117.63
Greenhouse laboratories		
Selective herbicides	14.50	18.00
Non-selective herbicides	6.50	3.00
Fungicides	4.13	4.00
Total laboratory volume	25.13	25.00
Woods/construction laboratories	New volume	Used/open volume
Paint	255.00	375.00
Solvents	72.00	76.50
Stains	107.75	172.00
Glue/adhesives	56.75	90.00
Total laboratory volume	491.50	713.50
Total laboratories volume	1,647.76	2,241.88
Respondents' chemical inventory (pounds)		
Greenhouse laboratories	New weight	Used/open weight
Fertilizer	523.00	402.00
Insecticides	65.00	52.00
Total laboratory weight	588.00	454.00

Agronomy laboratories	New weight	Used/open weight
Herbicides	0.00	88.00
Pesticides	0.00	0.00
Rodenticides	2.00	0.00
Insecticides	8.00	5.00
Fungicides	1.00	0.00
Fertilizer	10,013.00	0.50
Seed treat	0.00	5.00
Total laboratory weight	10,024.00	98.50
Total laboratories weight	10,612.00	552.50

Respondents' chemical inventory (cubic centimeters, cc)		
Animal husbandry laboratories	New volume	Used/open volume
Vaccines	900.00	560.00
Antibiotics	900.00	700.00
De-wormers	20,671.00	17,034.00
Antiseptics	3,785.00	11,356.00
Fungicides	0.00	0.00
Total laboratory volume in cc	26,256.00	29,650.00