

Agriculture and Food Education of High School Students in Ontario

By

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Abstract

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This research project aims to explore agriculture and food education programs, policies and curricula for high school students in Ontario, Canada. It seeks to understand the perceptions students have of their knowledge in agriculture, and evaluates the agriculture and food knowledge students actually have to determine how agriculturally literate they are. An understanding of the agri-food sector is important for a number of reasons that are discussed throughout this paper. This study employs a mainly qualitative methods approach to primary and secondary data collection. Some of the key organizations in Ontario that exist to non-formally educate young people about agriculture and food are summarized and discussed. Online surveys distributed to students in a rural and urban school of a school board in the Greater Toronto Area provide an understanding of their knowledge and perceptions. The surveys help to determine students' common sources of information and whether they would like to further explore the subject of agriculture for further learning and their career. This project also analyzed the Ontario high school science curricula to find themes of agriculture and food throughout. Lastly, recommendations for policy, programs and further research highlight the importance of youth learning about agriculture and food to ensure they are able to make informed decisions as consumers, improve their health, and become aware of the vast opportunities in the industry.

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Chapter 1: Introduction

Introduction

Everyday people are thinking about food, yet they might rarely know how it gets to their plate. Gradually, people are moving away from the countryside and into urban areas, which results in increased urban development, and more of a disconnect between the population and agricultural production. Not only is there a geographical, physical disconnect, but also often a gap in knowledge between those that work in agriculture, and those that consume its products. In Ontario, citizens are required to vote and participate in democratic decision-making. How can people make sound decisions when they lack the information needed to become informed on a particular subject and policy? There is an increasing need to provide education about agriculture to consumers so that the agriculture system is more widely understood and supported.

Agricultural literacy has been proposed as one of the solutions to this gap in knowledge about agriculture. Agricultural literacy is defined by Jones (2011) as “possessing knowledge and understanding the food and fiber system by being able to synthesize, analyze, and communicate fundamental information about agriculture” (p. 5). The United States of America’s National Research Council (NRC)(1988) states that, “...a person that is agriculturally literate should be able to understand agriculture’s economic, social, and environmental significance, and also have enough knowledge about nutrition to be able to make “informed personal choices about diet and health” (p. 2).

Related to the concept of agricultural literacy, is the idea of food literacy. These two concepts go hand-in-hand and will be used interchangeably throughout this research paper.

Food literacy, as defined by Cullen, Hatch, Martin, Wharf Higgins & Sheppard (2015) is

the ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan in order to navigate, engage, and participate within a complex food system. It's the ability to make decisions to support the achievement of personal health and sustainable food system considering environmental, social, economic, cultural, and political components (p. 143).

They also explain that food literacy follows "health literacy", and that addressing and increasing food literacy can help to decrease the prevalence of food related health problems that are currently on the rise today in Canada (Cullen et al., 2015).

Today's youth are the future – they are the next generation of consumers, so to speak. Specifically, high school-aged students are in a position where they are beginning to make decisions about the foods they consume. Many students reach the legal voting age of 18 in Ontario while they are in high school. Frohlich, Goldschmidt & Bogner (2013) argue that "it is important for the next generation to have enough agricultural literacy to be in a position to form well-rounded opinions about the future development of the agricultural industry and food production" (p. 62). This paper explores the fundamental components of agricultural literacy. There is potential for multiple avenues for agricultural education of youth – both formal – in the classroom, and non-formal – outside of the classroom. Organizations in Ontario exist with the mandate to provide agricultural outreach, education, and information to the public. Many of them have resources, events, and presentations aimed at educating youth and the general public about agriculture and food. These organizations will be explored and briefly evaluated in this research paper in terms of their efforts to improve agricultural literacy of young people.

Additionally, as much of the literature suggests, agriculture should be included as a component in the Ontario curriculum. Research insinuates that integrating agricultural topics within other subjects, such as science, can “increase interests of individual people in science by connecting real world applications with everyday lives” (Frohlich et al., 2013, p. 62). This idea is consistent with Balschweid’s (2002) argument that the “interface between context and content provides students with multiple opportunities for transfer and overlap of complementary concepts” (p. 57). This paper sets out to explore Ontario high school curricula in order to identify where agriculture, food and farming themes exist, and locate any gaps for curricula improvement and recommendations.

In order to pinpoint exactly where improvements need to be made in terms of agricultural education programs and subjects, it is important to identify a benchmark in terms of the agricultural literacy levels of youth in Ontario. Previous research pointed out many benefits of agriculture and food literacy. In order for individuals to reap these benefits, programs and educational opportunities should be improved so that they are able to improve their knowledge on agriculture and food. It is suggested that an increase in one’s agricultural literacy can improve their overall health and well-being, improve their ability to make informed decisions, – both democratic decision-making, and general food choices – expand their support for agriculture and the modern food systems, and also allow them to become more aware of the career opportunities that lay in the agriculture and food industries. Overall, as the population continues to increase, and urbanization remains, it is crucial that efforts are made to improve agricultural literacy of society’s future generations.

Rationale

Agricultural education is a noteworthy component of Ontario's agriculture system. Historically, when the majority of the population was located in rural areas and were involved in farm-work, education in agriculture was essential. This is what is considered *vocational* agriculture by the National Research Council (1988). In Ontario, the history of agricultural education dates back to 1847 when the first Normal School in Toronto was established for the training of teachers and the subject of agriculture was given importance (Woltz, 1914, p. 486). Progress was slow, but decades later agricultural textbooks were written and published, contributing to the materials that could be used for education on the subject (Woltz, 1914). At the time of Woltz's article (1914), agriculture was taught in elementary schools through studying nature, often through caring for animals, and school gardens. Around 1914, agriculture was adopted as a course in high schools as a unit in science, though not yet its own course (Woltz, 1914). In the early 1900s, it was especially important to have agriculture as part of the curriculum in rural schools in order to retain rural populations, and ensure individuals have the knowledge and training to work in the industry (Woltz, 1914). Woltz (1914) concluded that the main barriers were lack of time for teachers to incorporate agriculture, poor management, organization and lack of infrastructure in the schools, and a shortage of competent teachers for agricultural instruction. Even then, in 1914, education in agriculture appears unsettled and undetermined.

Over 100 years later, there is still a need to incorporate agriculture into the curriculum. However, rather than education *in* agriculture, the focus in this research is on education *about* agriculture – agricultural literacy (National Research Council, 1988). Now that most of the

Ontario population has moved away from the countryside, and into urban centers, there is no longer a need to focus on vocational agriculture, but instead, agricultural literacy – education *about* agriculture. The number of farms in Ontario, has decreased over the past two decades, while the size of the farms has increased for the most part (Statistics Canada, 2017a).

Specifically, the Greater Toronto Area (GTA) has experienced this trend of a decreased number of farms. Halton, Peel, York, and Durham are the counties that make up the GTA, along with the city of Toronto (Figure 1).

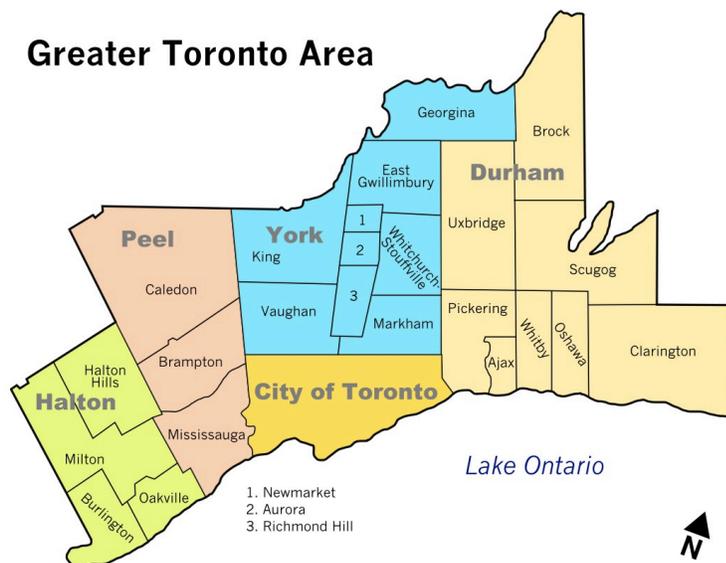


Figure 1: Map of the Greater Toronto Area (GTA)

Source: Gone Cheffing, 2018

In 1991, Halton was home to 744 farms, Peel had 711 farms, York had 1210 farms, and Durham had 2090 farms (Statistics Canada, 2017a). As of 2016, the number of farms in Halton decreased to 451, Peel to 408, York to 712, and Durham to 1323 (Statistics Canada, 2017a). A more detailed table of these trends is illustrated in Table 1.

Table 1: Number of Census Farms by County in the GTA, Ontario

County	1991	1996	2001	2006	2011	2016
Halton	744	720	619	566	469	451
Peel	711	689	522	483	440	408
York	1210	1211	1020	972	828	712
Durham	2090	2001	1709	1686	1454	1323
Total in GTA	4011	4621	3870	3707	3191	2894

Source: (Statistics Canada, 2017a)

As urbanization increases, it becomes clear that there is a need for education about agriculture. Most Canadians are at least one to two generations removed from agricultural production (Statistics Canada 2011). Only 1.4% of Ontario’s population is recognized as being the “farm population”, referring to farm operators and the individuals in their households (Statistics Canada, 2016). This research is important, as nearly 99% of the population is not directly involved in farm activities and might, therefore, have no other way to know about how their food is produced. Consumers are becoming increasingly skeptical about agricultural practices and food labels, and misconceptions and myths are often made about agriculture throughout the Internet. Incorporating agricultural literacy efforts into programming and the Ontario curriculum would eliminate the spread of misconceptions and help to increase the confidence consumers have for the food system.

Much of the research on agricultural literacy has been conducted in the U.S. as they have policy for agricultural education and efforts for programming. This particular research is important as it is one of the few pieces of literature on the subject of agricultural literacy focusing on Ontario. There is hope that this will open the door for more research on this subject to help bridge the gaps in this body of knowledge. Gaining a deeper understanding of

agricultural literacy in the context of Ontario will help to shape programming and efforts in this particular area.

Agricultural education has gone through many changes over the past century and a half, as shown through Woltz's article on secondary agricultural education in Ontario in 1914. It struggled to gain a place in the curriculum then as vocational agriculture, and it struggles to find a place in the curriculum now, as agricultural literacy. However, it remains clear that there is a need for agriculture in the overall education system, in whatever form that is feasible – be it formal or non-formal education. This research paper will explore the various aspects and opportunities of agricultural education and literacy. This research will contribute to the existing body of knowledge on agricultural education and literacy.

Methodology

This research project was designed to supplement the existing body of knowledge in agricultural education and literacy, by exploring the knowledge of high school students in Ontario and by understanding the opportunities available for young people to learn about agriculture. The original research design matrix can be found in Appendix A, and the revised research design matrix is in Appendix B. The style and scope of this research changed drastically throughout the process, and the differences in these two matrixes illustrates the many changes that occurred throughout the development of the study. The study employed a mainly qualitative approach to collect student assessments of their perceptions, understand what they already know about agriculture, and also, explore the channels of information that currently exist for students to educate them about agriculture. This data was collected by both secondary sourced material and an online survey instrument.

The secondary data collection involved creating an inventory of the organizations in Ontario which have a stake in agricultural education and improving agriculture or food literacy. There were specific criteria employed in this organizational search that will be further explained in Chapter Three. The other secondary data source for the inventory is the Ontario high Secondary School curricula. This method of data collection pinpoints exactly where in the curriculum themes around agriculture and food currently exist as it stands. Again, this section of the research will be further explained in Chapter Five.

The primary data was collected using a survey instrument, which included both open ended questions and Likert-type scale questions. This was able to provide a unique bridge to the secondary data from organizational resources and the high school curricula. The researcher was heavily influenced by the American agricultural literacy assessments by various researchers. Notably, Frick, Birkenholz, Gardner & Machtmes (1995) assessed the agricultural literacy levels of participants, as well as their perceptions of their agricultural literacy. The survey instrument created for this research included a section about how agriculturally literate students believed they were, and then later attempted to assess their actual level of agricultural literacy. Investigations were influenced by the “knowledge gap theory” as brought forward by Specht, McKim & Rutherford (2013). Multiple researchers attempted to understand if there is an agricultural knowledge gap between rural and urban populations. Results were inconclusive and inconsistent, and these authors found no major difference in terms of the agricultural knowledge between rural and urban samples. Therefore, this research seeks to do the same by testing the knowledge difference between students living in urban areas, and those who are residents of rural communities.

Additionally, much of the previous research focused on food purchasing behaviours, decision-making, and health. Therefore, it was imperative that this research include a section about food literacy and its influence on health. This section does not go into depth about health, as the investigator is not equipped with the knowledge to properly assess this. However, the survey results serve as a baseline in understanding the decisions that high school-aged students make regarding the food they consume. Agriculture is the avenue for food, therefore it seems appropriate to say that food literacy and agricultural literacy are one in the same, and it is important that this research considered these two concepts simultaneously. Together, all of these components seek to gain a deeper understanding of agricultural literacy in the context of Ontario, and these methods appeared as the most suitable means in achieving the research goal.

Research Goal and Objectives

The goal of this research is to grasp a better understanding of agricultural literacy and education in Ontario and contribute to the existing body of knowledge on agricultural education in Canada. The specific objectives were:

- 1) To identify the organizations that currently exist in Ontario that work towards helping youth achieve agriculture and/or food literacy,
- 2) To understand the perceptions and thoughts of high school students regarding agriculture,
- 3) To distinguish whether or not there is a difference between the agricultural knowledge of rural and urban students,

- 4) To find out where students get most of their information regarding agriculture and food and determine whether they obtain their knowledge and information from classroom or non-classroom sources (formal or non-formal education),
- 5) To determine whether or not students wish to learn more about agriculture and if they would consider careers in the agri-food industry,
- 6) To identify where the Ontario secondary school curricula include themes and suggestions for learning about agriculture and food.

Significance and Limitations

There are several limitations associated with this particular research paper that are important to point out. Despite the attempts to include as many respondents for the survey as possible, only one school board in the GTA approved for this research to take place. Within this school board, only two schools were selected due to convenience and based on the time remaining to collect data. Thus, the participants were not a truly random sample which further acts as a limitation to this research. While it would have been beneficial to include more schools and more school boards if possible, the two schools that did take part in the research were sufficient and serve as a door-opener for similar case studies.

In terms of information resources for the literature review and background on the subject, some agricultural education organizations that were approached declined the request to provide insight and recommendations for improving the survey instrument. Therefore the questions were derived based on previous research conducted in the U.S., and gaps from the literature in Canada. While recommendations from Ontario organizations would have been

beneficial, the use of the U.S. survey examples eliminated the potential for increased bias of particular organizations and individuals.

Another limitation in the curricula analysis was the inability to speak to teachers and curricula writers. There was a close substitute in the form of Kornelson's (2010) research which evaluated teachers in Ontario and the role that they play in food and agricultural education. Kornelson (2010) identified the opportunities and barriers to educators' teaching of agriculture and food concepts within the curriculum. Teachers felt the pressure of curriculum expectations, voiced that subject priorities for education lie elsewhere, are uncomfortable or uninterested in the content, and felt that there was a lack of infrastructure and support for teaching the subject (Kornelson, 2010). It would be beneficial to speak to the Ontario Ministry of Education about these curricula resources and inquire about the support documents available for teaching agriculture and food topics. Some schools might also put more priority into agriculture and food education than others, and the curricula do not give any indication of this. This is due to the freedom within the curricula, and objectives of individual schools throughout Ontario.

A further limitation in the study is the small sample of participants and the context-specific nature of this study. It is recognized that one student's knowledge is specific to them, and there are many factors that shape their learning experiences and understanding of a subject. All people comprehend things differently, based on their competency, behaviour, personality, and environment (Hopwood, Donnellan, Blonigen, Krueger, McGue, Iacono & Burt, 2011). One student with similar demographics as another, might have a very different understanding of the agri-food system than their peer. Therefore, results cannot be

generalized across student populations and other demographically similar schools or areas of the province. Additionally, the student participants are trusted that they provided honest, and accurate answers in the survey, and replied to the best of their ability. It cannot be certain, however, that they did not “guess” answers in the agricultural literacy assessment. This research relies on participants to give their opinions and share their knowledge as best as they can and a margin of error can be expected.

The final limitation to point out is the time constraints of this research. The depth and scope of the curricula analysis portion of the research were affected by time availability. It would have been beneficial to delve further into other Ontario secondary school curricula such as the social sciences, history, and technological education to identify areas where agricultural literacy is encouraged. However, these curricula were lengthy, and not quite as relevant for this research. Science curricula were the focus of this research because of their strong relationship with agriculture and food mentioned in the literature. Additionally, the data collection period depended on the time constraints placed by the school board and the schools participating. The school board has “black-out” periods when external research is prohibited. The ethics application required to conduct research within the school board took time to process and receive approval. By the time it received approval, there was little time before students went on holidays, and when they returned, it was a “black-out” period until semester turnaround. Thus, results from this research were affected by the operations of the schools, the school boards, the participants, and the program timeline.

This work offers a brief, but important contribution to the topic of agriculture and food education in Ontario. While there currently does not exist substantial research on this topic

within the context of Ontario, the study sheds light, in an exploratory manner, on a few of the specific components of agricultural education in the province.

Overview of Research Paper

The structure of this research paper is comprised of six chapters. Chapter One provides an introduction to the paper, including the goals and objectives, the important concepts and terms, and a brief history and description of agriculture and agricultural education in Ontario. Chapter Two is a literature review of the works related to agricultural literacy and education, as well as connected fields. Chapter Three provides an overview of the organizations in Ontario that contribute efforts in improving agricultural literacy of youth and includes a description of the resources and programming that they provide. Chapter Four discusses the results from the qualitative survey that assesses the knowledge of high school students in a school board in the GTA. Chapter Five seeks to pinpoint exactly where in the Ontario curricula themes around agriculture and farming exist. This section will also include a section on the barriers to inclusion in the curricula and instruction of agriculture by teachers. Chapter Six will summarize the previous chapters into relevant conclusions drawn and include recommendations for future policies and research on agricultural education and literacy.

Chapter 2: Agricultural Literacy and Education - a Review of the Literature

Introduction

The world's population is expected to increase to 9 billion people by the year 2050. This is echoed in much of the literature around development, sustainability, agriculture, and food security. In order to sustain such a large population, the world's agricultural systems must undergo changes and implement technology that assists producers in growing and raising food more efficiently. While the population increases, it is also inevitable that urbanization and pressure on agricultural land increases. Consistent with the need to strengthen the agricultural systems that the population so heavily relies on, is the need to educate people about the complexities of farming and food production. Fewer and fewer people will be directly involved in agricultural production, therefore the vast majority of the population will not have a strong understanding of its system and the complexities involved with farming (Kovar & Ball, 2013). Consumers and citizens play an important role in the agricultural systems they rely on, as they are responsible for making decisions about the foods they purchase and eat. Additionally, in most nations, citizens and their decisions influence agricultural policies. Thus, seeing as individuals are responsible for making decisions regarding policy around food and development, it is imperative that they are informed through agricultural literacy initiatives and efforts (Kovar & Ball, 2013).

Agricultural literacy is defined in this paper as an "understanding of the food and fiber system that includes its history and current economic, social, and environmental significance" (Kovar & Ball, 2013, p. 168). In North America, the literature on this topic points to the United

States of America's National Research Council's (NRC) Committee on Agricultural Education in Secondary Schools 1988 publication titled *Understanding Agriculture: New Directions for Change*. This committee was established in the hopes of producing agriculturally literate and informed citizens that are better equipped to participate in the establishment of policies that support the agricultural industry (NRC, 1988). By making recommendations about goals for instruction in agriculture topics for the K-12 curriculum (NRC, 1988), youth were able to benefit by learning about food and farming at school. Although this was an American policy review, the need for global agricultural literacy was emphasized because national agricultural systems are linked, often interact, and are dependent upon each other (Pant, Hambly-Odame, Hall & Rasheed, 2012).

This chapter is a review of literature on agricultural education which will first seek to explain the concept of agricultural literacy. While the definition of agricultural literacy was first created in America, the Canadian agricultural system experiences many of the same interests. Therefore, Canada has the opportunity to adopt these efforts to increase agricultural literacy amongst its population. Relevant academic literature on the subject, as well as policy around agricultural literacy and education will also be explored. Agricultural literacy has been researched by academics in the Canadian context since the start of the 20th Century. In the present day, the need for policies supporting agricultural education efforts are voiced by multiple organizations and individuals. It has become clear through this review and research that there are opportunities for further exploration of the subject, with a specific focus on Ontario. The central argument of this paper is that to prevent public misunderstanding of the

sector, improve health and well-being, and increase informed decision making, it is crucial that students become agriculturally literate.

Agricultural Literacy as a Concept

As previously noted, much of the general information around agricultural literacy stems from and points back to the American National Research Council's *Understanding Agriculture: New Directions for Education*. The National Research Council's definition of agricultural literacy is echoed throughout the other academic literature. Another important definition of agricultural literacy is by Anderson, Velez & Thompson (2014):

Agricultural literacy entails knowledge and understanding of agriculturally related scientific and technologically-based concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. At a minimum, if a person were literate about agriculture, food, fiber and natural resource systems, he or she would be able to a) engage in social conversation, b) evaluate the validity of media, c) identify local, national, and international issues, and d) pose and evaluate arguments based on scientific evidence. (p. 133)

The concept of agricultural literacy is complex and encompasses a variety of fundamental components. Particularly, the concepts of analyzing the media, summarizing, and communicating information are especially important in this definition. This is enforced by Leising et al.'s (as cited in Colbath & Morrish, 2010) definition, whereby "an individual possessing such knowledge [of food and fiber systems] can synthesize, analyze, and communicate basic information about agriculture" (p. 15). This definition comes from the Food and Fiber Systems Literacy Framework developed in 1998, which contains suggestions for agriculture in the curriculum as well as tools to measure agricultural knowledge based on five themes: "1. Understanding food and fiber systems, 2. History, geography, and culture, 3.

Science, technology, and environment, 4. Business and economics, and 5. Food, nutrition, and health” (Colbath & Morrish, 2010, p. 15).

The National Research Council (1988) highlights two types of agricultural education – agricultural literacy (education *about* agriculture), and vocational agriculture (education *in* agriculture). Vocational agriculture was historically supported by policy in the curriculum (NRC, 1988). At that time, a large portion of the population lived on farms, therefore it was mandatory that they learn about agriculture in school, as many of them would be going home to work on their farms. Certain crises in farming had huge effects on vocational agriculture education, and children who “might have followed their parents into farming or worked in a farm-related service industry or business often now have little interest in agriculture” (NRC, 1988). Due to this decline in interest or opportunity for taking up agriculture as a career, vocational agriculture was taken out of the core curriculum, and specialty programs were put into place whereby students were given the choice to enroll (i.e. Agriculture programs in colleges and universities).

Canadian research on agricultural literacy began in 1914 with Woltz’s (1914) review of Agricultural Education in Ontario Secondary Schools. In Ontario, the number of farms has dropped from 59,728 in 2001, to 51,950 in 2011 (Canadian Rural Revitalization Foundation, 2015). In 2001 across Canada, there were 246,923 farms, and this number dropped in 2016 to 193,492 farms across the country (Statistics Canada, 2017). Over the past few decades farmland has been engulfed by development of cities due to urbanization. With less than 2% of the population living or working on farms, much of the population has become two to three generations removed from the agricultural system (Colbath & Morrish, 2010). Therefore, there

is a massive disconnect between those working directly in agriculture, and those not. Due to the absence of agriculture in the curriculum, students are left with a lack of opportunity to learn about agriculture, and thus become agriculturally illiterate.

Food Literacy

Similar to the concept of agricultural literacy, is the emergent idea of *food literacy*.

Cullen, Hatch, Martin, Wharf Higgins & Sheppard (2015) define food literacy as the

ability of an individual to understand food in a way that they develop a positive relationship with it, including food skills and practices across the lifespan in order to navigate, engage, and participate within a complex food system. It's the ability to make decisions to support the achievement of personal health and sustainable food systems considering environmental, social, economic, cultural, and political components. (p. 143)

Agricultural systems are what produce food for the population, therefore these two concepts go hand-in-hand. Cullen et al. (2015) emphasize the need for Canadians to possess knowledge and skills surrounding food, and to have a strong understanding and sense of connectedness to the food they consume. Because the modern food and agriculture system have become so complex and distant to consumers, the "path from field to plate" (p. 140) is not as easily identified and understood as it historically was (Cullen et al., 2015). Amongst children especially, rates of obesity and diabetes are increasing, and embedding food literacy and agricultural literacy is looked to as a solution to curb these health pandemics (Baker, Campsie & Rabinowicz, 2010).

Kornelsen (2010) describes food education as "educational resources and activities that explicitly encourage greater food, agricultural and health literacy", including "an understanding of agricultural and natural resource systems, a basic ability to prepare culturally appropriate meals oneself, and an understanding of what constitutes a healthy diet, from a nutritional

perspective, as well as an environmental one” (p. 3). These definitions highlight agriculture as a component of food literacy, therefore both agriculture and food literacy can be considered as joint concepts.

Agricultural Literacy from the Academic Perspective

Many academics across the U.S. and some from Canada have made agricultural literacy a theme in their research. They have explored agricultural education from the perspective of teachers, as well as elementary, high school, and college students. This section will focus on this type of research, noting few key articles that are important for studying agricultural literacy and education moving forward. It is divided into three sections – agricultural literacy and the role of teachers, agricultural education and literacy in elementary schools, and high schools and beyond.

Teachers and their Influence on Agricultural Education

Firstly, teachers are the major influencers of learning for students at any level. Teachers are guided by the curriculum, but have the ability to choose what method and medium they use to relay information to their students. Anderson et al. (2014) conducted qualitative research with a group of teachers at the Oregon Summer Agriculture Institute (SAI). The SAI is a program for teachers to take part in throughout the summer that helps them to learn about different ways to incorporate agriculture into their classroom (Anderson et al., 2014). Rather than seeking to understand teachers’ *perceptions* of agriculture, the term *conceptions* was used instead as this recognizes the shift from passive to active thinking (Anderson et al., 2014). Anderson et al. (2014) explain that “in order to form conceptions, participants must engage and create meaning by putting in substantial thought” (p. 133). They began with an entrance

questionnaire that tested their knowledge about agriculture, and towards the end of the program interviews were conducted and reflective journals were collected from teachers (Anderson et al., 2014). They found that teachers became more agriculturally literate through this program, especially those that had minimal understanding prior to their participation (Anderson et al., 2014). Anderson et al. (2014) emphasized the need to increase agricultural literacy of our society in order to sustain agricultural systems.

The literature by Colbath & Morrish (2010) also recognize the obvious role of teachers in agricultural education. It is explained that it is often very difficult for public school teachers to implement agriculture-based curriculum due to accountability measures (Colbath & Morrish, 2010). To curb this issue, they recommend that agricultural education be implemented at the post-secondary level (Colbath & Morrish, 2010). This problem is reiterated through the work of Kornelson (2010), whereby she recognizes that while teachers might have freedom within curriculum to teach agriculture, there are often many barriers to their inclusion of this subject. These barriers found by Kornelson (2010) are as follows: 1) Pressure of curriculum expectations; 2) Curriculum priorities are elsewhere; 3) Teachers are uncomfortable or uninterested in content; and 4) General barriers, such as lack of infrastructure, ambivalence about topics, and subject fragmentation (p. 78-83). While there are many barriers to teachers incorporating agriculture into their lessons, there are also many opportunities - which will be further discussed in the Chapter Five.

Frick, Birkenholz, Gardner & Machtmes (1995) state the need for teachers to be encouraged to develop a better understanding of the significance of agriculture nationally, and globally. In Frohlich, Goldschmidt & Bogner's (2013) article, 5th, 6th, and 10th graders'

conceptions about farmers' duties were explored. While they found that students weren't very familiar with duties of farmers, they recognized the need to educate both students *and* teachers to improve agricultural literacy (Frohlich et al., 2013). Furthermore, seeing as children and youth spend the majority of their day in a school setting, teachers have the ability to act as important, healthy role models for their students and have a positive influence on them (Korzun & Webb, 2014).

While many authors emphasize the role that teachers have in agricultural education Adamo, Goldfield, Colapinto, Grattian, Harvey & Barrowman (2013) point out that this might not be the best approach. Through their evaluation of the overall effectiveness of a fruit and vegetable program in Eastern Ontario, they found that knowledge and consumption around fruit and vegetables did not increase through this approach (Adamo et al., 2013). The program they examined consisted of a single visit from an external group and was followed by programming led by the teacher (Adamo et al., 2013). To elicit a change in behavior of this sample, this approach of food education – relying on the external program group and a teacher lesson was found to be ineffective (Adamo et al., 2013).

Finally, based on the literature, there is clear need to increase the capacities of teachers with agricultural knowledge so that they are better equipped to teach these subjects. Their increased understanding of the agriculture and food systems will enable them to create and implement instruction in agriculture that can be integrated into the curricula.

Agricultural Education in Elementary Schools

There are many opportunities to integrate agriculture into elementary curricula. This area of agricultural education research is explored by a number of authors. Firstly, the work by

Barton, Koch, Pamela, Contento & Hagiwara discusses (2005) discusses the need for scientific literacy, rather than agricultural literacy specifically, however, agriculture and food education fall into this category. Similar to the National Research Council's (1988) urge to increase agricultural literacy, for scientific literacy, Barton et al. (2005) vouch for the need to enable students to learn about and experience the natural world, use science to help make decisions, engage in public discourse through science, and increase economic productivity. In their study with elementary-school-children, they found that students held a "black-box" in terms of their understanding of what happens to food between the farm and the store, meaning they had a weak understanding of the process of food (Barton et al., 2005). They also noted that many students lose interest in science by the time they are done middle school, therefore an approach is needed that helps to increase their level of engagement with scientific material (Barton et al., 2005). Seeing as "eating is necessary for survival" (p. 1164), it is important to increase children's familiarity with food, and "instruction that seriously builds on what students know and care about can serve as a hook that gives them ownership of the content being learned" (Barton et al., 2005, p. 1164). Therefore, as they found that students in elementary schools were science illiterate when it came to their knowledge about food, they suggest that teaching science through food, in grades 4-6 especially, would prove to be extremely useful and beneficial for all (Barton et al., 2005).

Another piece of literature that analyzes the relationship between food and elementary school-students is by Hess (2011). Similar to the previously discussed article, this one focusses on urban youth specifically and stresses that humans are dependent upon agriculture to meet their needs, therefore they should have a strong understanding of its systems (Hess, 2011).

Hess (2011) points out the changes that the agri-food system has undergone to increase productivity and meet the needs and demands of the increasing population, therefore it is important to help citizens understand this complex system so that they are better equipped to engage in the decision-making process. Using grade specific benchmarks, Hess (2011) compared students from grades four to six's understandings of agriculture to expert conceptions. It was found that the informants lacked background which acts as a foundation for agricultural knowledge and understanding (Hess, 2011). Also, most students lacked compatibility in terms of knowledge compared to the grade-specific benchmarks as developed by experts on agricultural education (Hess, 2011). Hess (2011) concluded that participants lacked schemata which is needed to articulate an understanding of what agriculture, in general, is.

The final piece of literature to be discussed in this section is the article by Kornelson (2010). Kornelson (2010) mentions the issue whereby "more and more children lack the opportunity to both develop both practical food skills at home, and a strong knowledge of food and agricultural systems at school", therefore "entire generations are at risk of becoming wholly dependent on the industrial food system; the social, environmental and health costs of which we are beginning to see" (pg. 2). People generally lack the skills and knowledge to understand this modern, industrial food system and all that it encompasses (Kornelson, 2010). Further, she explains the concept of food citizenship as "the practice of engaging in food-related behaviours...that support, rather than threaten, the development of a democratic, socially and economically just, and environmentally sustainable food system" (Kornelson, 2010, p. 3). By studying students', their teachers in elementary schools, Kornelson (2010) found that

agriculture and food is not heavily taught in the classroom environment. Some of the benefits to food education that were summarized by Kornelson (2010) are as follows: “influencing purchasing decisions”, “positive eating practice”, “connectedness to community and world”, “increasing connectedness to nature”, “empowerment”, “recognition of farming as a career”, and “recognition of health-related illnesses” (p. 62). With all of these benefits of learning about agriculture and food, it is extremely important students are given this opportunity in elementary schools especially so that they grow up as “food citizens” (Kornelson, 2010).

Agricultural Literacy Amongst High School Students and Beyond

Not only is agricultural education important in elementary schools, but also in high school systems and educational institutions beyond the secondary level. The benefits to learning about agriculture that were previously mentioned, also extend to people of all ages, throughout the entire basic schooling experience, into college and post-secondary institutions, and also the general public – encompassing all consumers. After all, Frick et al. (1995) state that “consumers need to be agriculturally literate in order to respond appropriately as issues arise” (p. 1). The goal of Frick et al. (1995) was to assess the level of agricultural literacy amongst high school students as well as their perceptions of agricultural literacy, in order to improve the efforts to increase agricultural literacy in the given population. A comparison was made between the knowledge of rural high school students and urban high school students in two Midwestern states (Frick et al., 1995). Based on seven concept areas, including “societal and global significance of agriculture”, “public policy in agriculture”, “agriculture’s relationship with environment”, “plant science”, “animal science”, “processing of ag products”, and the “marketing and distribution of ag products” (p. 3), participants were given 35 perception

statements with which they were to rate their amount of agreement or positivity towards – using a Likert scale (Frick et al., 1995). Frick et al. (1995) found that rural high school students produced a higher group mean knowledge score for each of the seven concept areas, and also had a more positive perception towards agriculture. It was concluded that these findings might have been due to the fact that rural populations were increasingly likely to interact directly with farmers and other people working in agricultural businesses (Frick et al., 1995). Also, more efforts should be made to provide agricultural education programming in larger population centers to meet the needs of the population that don't interact directly with producers, in order to close this knowledge gap about agriculture and food (Frick et al., 1995). This research is a good example of the urban and rural divide in terms of agricultural knowledge.

This issue is further enforced by the National Research Council's article from 1988. They found that agricultural education in high schools, specifically, does not cover "education about agriculture", but instead focusses on "education in agriculture", which is vocational agriculture (NRC, 1988). While this article is from 30 years ago, this is still often the case. Vocational agriculture programs that still exist are often located in rural areas, and urban schools have the least amount of access to them (NRC, 1988). The National Research Council (1988) recognize that agricultural education is more than just vocational agriculture, it is agricultural literacy as well, and "education is incomplete unless students learn what is essential for the lives of our crops, animals and plants" especially as this is our food system (p. 8). Though this study originates from the U.S., the same can be said for Canada – all citizens deserve to learn about agriculture and it would be beneficial to start with students so that they grow up as informed individuals and consumers.

Agricultural literacy has also been evaluated and explored at the post-secondary level. Colbath & Morrish (2010) studied agricultural literacy of college freshmen in Texas. Overall, it was found that students were agriculturally illiterate (Colbath & Morrish, 2010). They note that “agriculture should be considered a critical aspect of general education throughout the public-school system”, however, “implementation at the college level would also help close the gap of agricultural illiteracy since it is sometimes difficult for public school teachers to implement such a curriculum due to accountability measures” (Colbath & Morrish, 2010, p. 17). Additionally, the topic of genetically modified (GM) foods has become a controversial issue debated by many, especially millennials. Ruth, Rumble, Gay & Rodriguez (2016) did a study about undergraduate students’ attitudes towards GM foods. Because GM foods are a product of agricultural technologies, education about this subject area is increasingly important, and also considered controversial. Ruth et al. (2016) found that while students reported they possessed a high amount of knowledge about GM foods, the results from the qualitative data proved that they do not necessarily understand as much as they indicated. Communication and information sources are important influencers of one’s knowledge, and students reported they were not sure where to find credible, and correct information on GM foods (Ruth et al., 2016). Ruth et al. (2016) suggested that universities and colleges that have agriculture and food departments should consider offering agricultural issues classes or other agricultural literacy programs to non-ag students so that everyone has the opportunity to learn about food and contentious topics such as this.

The idea that “increased modernization and urbanization has created a disconnect between the population and agriculture” (p. 2) is echoed by Jones (2011). In Jones’ (2011)

study about the agricultural knowledge of incoming freshmen at Oklahoma State University, it was found that students did not possess even a “passing knowledge of agriculture” (p. 67). Additionally, students from a city scored a much lower score on the agricultural literacy evaluation than students from a small town or rural community (Jones, 2011). Though it was previously found that “people regularly overestimate or underestimate their actual abilities” (Hoy & Spero in Jones, 2011), Jones (2011) found that student’s perceptions about their knowledge surrounding agriculture were generally accurate.

Interestingly, Utah State University offers a Food literacy course for undergraduate students, whereby its goal is to “give students the opportunity to reconnect with the origins of food they consume, while aiming to dispel myths about food from farm to fork” (Bevan, 2016, p. 99). Students in this course are taken on a field trip to a large local dairy farm in their area, where they listen to a presentation, see the dairy farm first hand, and sample the dairy products (Bevan, 2016). It was found that the “majority of students indicated that the dairy farm tour gave them a more positive perception of dairy foods and farming” (Bevan, 2016, p. 99). This piece of literature is especially important because it shows the value of experiential learning at all points in the production system. Students had the opportunity to see a dairy farm first-hand, and also the process from farm to fork by having the chance to sample the products from the farm.

Policy for Agricultural Literacy and Education

While there are abundant pieces of academic literature on the topic of agricultural literacy and education, there have also been suggestions in the literature for policy reforms around agricultural education and food literacy.

Firstly, the Metcalf Foundation in Canada discusses the idea of the “Good Food Gap”, which “represents the policy space separating the farm income crisis from the health crisis”, where “farmers find it difficult to make a living growing food, and consumers find it difficult to make the good food choices they want to make” (Baker & Rabinowicz, 2010, p. 9). They propose a list of ten “good food ideas” for Ontario to rebuild the local food supply chain and agriculture system, and one of these ideas is to “implement a school food program, and embed food literacy in the curriculum” (Baker & Rabinowicz, 2010, p. 7). Baker & Rabinowicz (2010) explain that in Ontario, one in nine children live in poverty, and there are increasing rates of obesity and diabetes amongst youth. With school food programs and efforts to increase food and agricultural literacy, these issues could be alleviated, and students would be able to focus more on their studies and ensure their health for the future (Baker & Rabinowicz, 2010). Since 1988 the U.S. has implemented student food education policies, Canada could look to them for school food program models (Baker & Rabinowicz, 2010). They argue that children should be supported to learn about healthy food choices and should have the opportunity to obtain food skills through the curriculum (Baker & Rabinowicz, 2010).

Similar to The Metcalf’s Foundation’s urge to implement food and agriculture literacy programs into schools, is OFA’s suggestion to implement a food literacy component into the school curriculum specifically – focusing on formal education. The Ontario Federation of Agriculture (OFA) released a report in 2017 titled *Food Literacy Attitude and Awareness Research Report*. The purpose of this project was to better understand what consumers in Ontario currently know about agriculture so that programs, resources and information get better targeted (OFA, 2017). OFA (2017) studied three groups – parents with young people,

early millennials, and teenagers. Overall, they found that consumers had a limited amount of knowledge about agriculture and local food production in Ontario (OFA, 2017). Some of the common misconceptions that were found were related to “the treatment of animals”, “pesticides, hormones and antibiotic use”, “size and ownership of farms”, and the “impact agriculture has on the environment” (OFA, 2017, p. 5). Contradicting previously mentioned studies, was OFA’s (2017) finding that consumers in rural Ontario do not have more knowledge and understanding about agriculture, local food production, and local food knowledge in Ontario, thus “local food knowledge and understanding does not drastically change based on residential location” (p. 7). It was also found that consumers have an understanding of local food products, but not of the farming practices or overall food production systems (OFA, 2017). The OFA (2017) concludes that the gap in knowledge about food and agriculture is a major issue, and food and agriculture need to be implemented into the curriculum through the government and public policy. Thus, according to the OFA (2017), “improving food literacy is a long-term solution that ends with a healthier population and a less taxed health care system, but the solution is dependent on support and engagement from both government and the public” (p. 9). This is a strong conclusion, but their findings from this project were influential, especially for the context of Ontario and implementation of agriculture in the curriculum.

Also argued in the literature, is the need to educate planners about agriculture and the benefits of an existing local food system (Brinkley, 2012). For decades, urbanization has been favoured by planners over rural landscapes (Brinkley, 2012). Indefinitely, “more attention needs to be paid to preserving these highly valuable farming areas”, therefore planners should be educated on ways that they can better reconnect farms with the city and slow urbanization

as it engulfs precious farmland (Brinkley, 2012). Brinkley (2010) concludes that “the loss of agricultural land to development, the disconnect between local farms and their urban markets, and the recent drive to create sustainable, green infrastructure has engendered a variety of planning programs to reconnect farms with the city” (p. 260).

Hubert, Frank and Igo (2000) urge for environmental and agricultural literacy education, while they explain that urbanization and development has caused people’s basic understanding knowledge about the environment and its interrelated systems to decline. This is concerning because the lack of knowledge and understanding by the general public for agriculture and its processes could be considered as part of the problem of urbanization that engulfed the fertile farmland (Hubert et al., 2000). While these findings are from the U.S., the same trends can be seen in Canada. Of course, people’s opinions and perceptions are influenced by the media, however much of the media coverage on agriculture has not been portrayed in a positive or correct light, possibly because journalists also lack a solid understanding of these matters (Hubert et al., 2000). This has led to the creation of many myths and misperceptions among consumers, which has resulted in a lack of support for agriculture by the general public. Hubert et al. (2000) emphasize the need for societal knowledge about agriculture for two reasons: “as consumers of agricultural goods, people to need understand basic principles of agriculture”, and “because of roles citizens play in policy decisions, people need to understand the impact of agriculture upon society, the economy, and the environment” (p. 526). Along with agricultural awareness, is the need for media awareness – as media has the potential to be used to provide the correct information about agricultural and environmental issues using scientific knowledge to facilitate understanding (Hubert et al., 2000).

There is a great deal of literature on the topic of agriculture & food education and the role of policy. The literature mentioned the urge for policies that support children's learning about agriculture and food, as well as planners, decision-makers, and general consumers.

Conceptual Framework

Theoretical perspectives on this subject have suggested that teaching agriculture as part of the science curriculum in schools is both productive and effective. For example, Balschweid (2002) uses brain-based theory and experiential learning theory to "suggest that the interface between context and content provides students with multiple opportunities for transfer and overlap of complementary concepts" (p. 57). Thus, by using agriculture as a method of teaching science to high school students, they will be able to learn more effectively as they will be able to understand scientific concepts using agriculture and food as the context that they can easily relate to and understand.

Specht, McKim & Rutherford (2013) apply "knowledge gap theory" first introduced by Tichenor, Donohue & Olien (1970) to their study of agricultural education. Their general hypothesis is:

As the infusion of mass media information into a social system increases, segments of the population with higher socioeconomic status tend to acquire this information at a faster rate than the lower status segments, so that the gap in knowledge between these segments tends to increase rather than decrease (Tichenor et al., 1970, p. 159-160).

Rumble & Buck (2013) elaborate on this theoretical approach by stating that "mass media infusion is absorbed at different rates across different socioeconomic groups, thus impacting the rate of information obtained by individuals" (p. 4). To put knowledge gap theory into the context of agriculture, it can be said that those who are directly involved with agriculture do

not necessarily have the resources available to share information and their knowledge within the media (Rumble & Buck, 2013). Currently, much of the information that is in the media about agriculture is misinformation, producing many negative and unrealistic perceptions of the industry by the general public. Thus, as more people move further away from the farm, as previously explained, the need for agricultural knowledge by all decreases, which leads to an agricultural knowledge gap (Specht et al., 2013). This “limited knowledge makes the public’s views uncertain and malleable, opening the door for media portrayals of the industry to heavily influence public perceptions” (Specht et al., 2013, p. 65).

Eliminating the agricultural knowledge gap requires education on the subject, starting with high school students. Education in agriculture would produce youth that are agriculturally literate, and because agricultural literacy is a component of food literacy, students would also better understand food. There are many benefits that stem from agriculture and food literacy as outlined in the previous review of the literature. High school students are future consumers; they are beginning to make their own choices regarding their food and are reaching the age where they are able to vote and participate in democratic decision-making. Generally, once a person achieves agriculture and food literacy, they have access to a number of benefits. Education about agriculture for youth – high school students specifically, for this research, as they are the future consumers – will help to achieve agriculture and food literacy. This education can be delivered by providing the knowledge and information either in or outside of the classroom environment. These components are what make up the focus of this study which is illustrated in the Conceptual Framework (Figure 2).

The focus of the study is firstly, to determine what organizations exist in Ontario to assist youth in achieving agricultural literacy. Secondly, this study seeks to understand the thoughts and perceptions of high school students regarding agriculture and find out whether or not there is a difference in agricultural knowledge between urban and rural students. There is focus on where students get most of their information regarding agriculture and asks if they wish to learn more in the future about this subject. Third and lastly, a small component of this research focusses on whether or not students are aware of careers in the agri-food industry and seeks to determine if they have ever considered working in this sector.

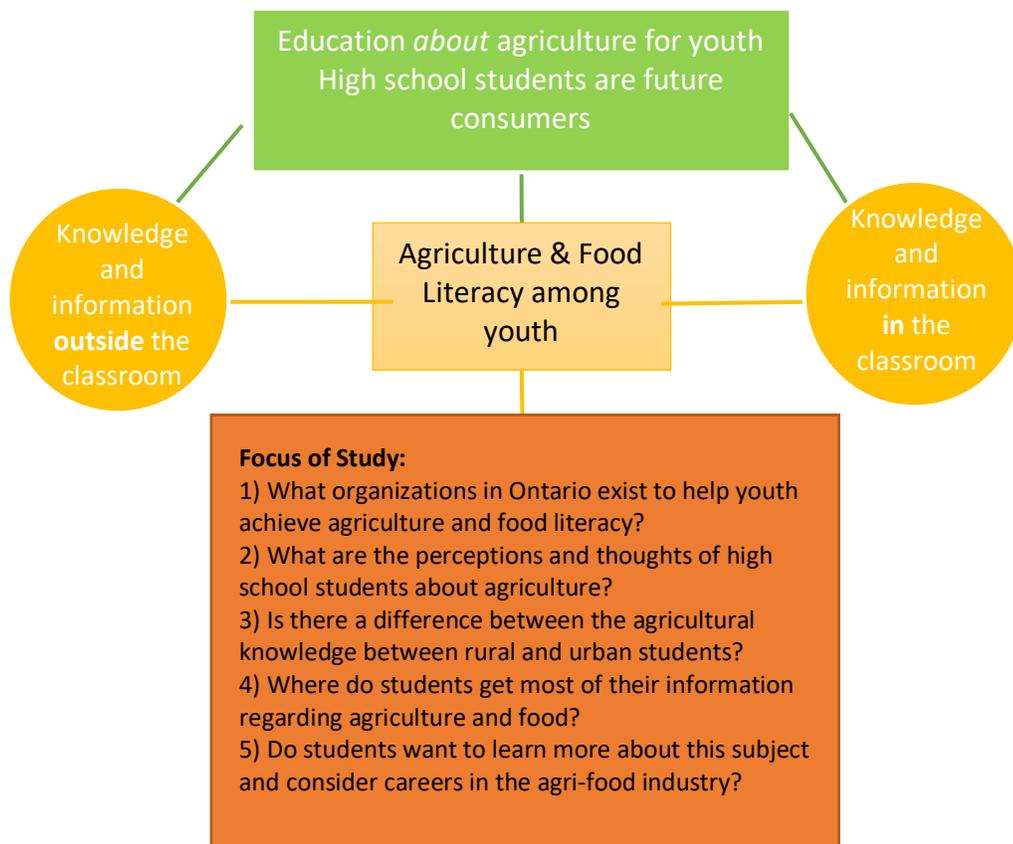


Figure 2: Conceptual Framework for Understanding Agricultural Literacy and Education

Summary

As this chapter explained, the simplest definition of agricultural literacy is the “understanding of the food and fiber system that includes its history and current economic, social, and environmental significance” (Kovar & Ball, 2013, p. 168). The need for agricultural literacy amongst the entirety of the global population was highlighted by many researchers that study agricultural education. Also, because agriculture and food go hand-in-hand, there is a need for food literacy, especially amongst children to help decrease incidents of diabetes and other health pandemics. Students are influenced by their teachers; therefore, it is important that teachers and other influencers are educated in agriculture also. Agricultural literacy assessments have been made amongst elementary and high school students, as well as post-secondary students, mainly in the U.S. However, it would be useful to better understand the need for agricultural education in the context of Ontario.

Policy suggestions for education about agriculture have been made by many individuals and organizations. It is a consensus that agriculture and food topics should be implemented into the curriculum. Along with this, it is important to understand where exactly these terms and concepts currently are found in the Ontario curricula. It was made clear that food programs that encourage children to develop food skills will help to decrease diabetes, obesity, and other negative health issues associated with poor food choices and lack of food skills. Consumers of agricultural goods are the ones making the decisions in policy around agriculture and food, therefore it seems rational that they are educated on these topics to increase informed decision-making. Overall, the literature included many excellent points and clearly identify the need across North America for formal and non-formal agricultural education

policies, programs and curricula. We now turn to a review of these issues in the context of Ontario. The next section will highlight some of the organizations in Ontario that offer agriculture or food education to young people.

Chapter 3: Agricultural Education in Ontario

Education, Outreach, Programs, and Resources

Many organizations exist globally, nationally, and provincially with a mandate related to extending information about agriculture, food, and farming to the public – some focus on general consumers, other focus solely on youth, and some on students. This section of the paper seeks to offer an information and resource library of organizations offering non-formal agricultural education. Non-formal education is defined here as programs that are based outside the formal school system, although some of these programs may be offered in schools or as complements to formal education in agriculture and food-related curricula. For each organization, the investigator has attempted to track down the vision, focus, key activities, their main successes or challenges, the types of resources they offer to youth, and also their website for further information. This inventory of organizations can be found in Appendix C.

Criteria for Search

There were specific criteria or “key words” for this search for organizations that offer agriculture and food education. First, the organization had to have some sort of program, resource, or activity geared towards young people, between the ages of four and 18. This age range was chosen because children of these ages are in school, somewhere between kindergarten and grade 12. Some organizations might focus on elementary aged students, or high school students – if there are specifications for targeted ages or grades, this will be stated within each organization. Another additional piece of criteria was that the organization had to be doing outreach, education, programming, and/or have “resources” to offer young people age four to 18. Finally, their activities had to involve agriculture, food, or farming. Eight

organizations offering non-formal education for youth regarding agriculture and food will be outlined in Appendix C.

Summary and Evaluation of Food and Agriculture Education Organizations in Ontario

It is important to bear in mind that this list of organizations that are involved in food and agricultural education is not exhaustive. There are other organizations existing in Ontario that do work around food and agriculture literacy, however, for the purpose of this research, this list was not meant to be comprehensive. This list sheds light on some of the good news stories that are happening around this work and seeks to inspire the creation of organizations that further the education of youth in agriculture and food topics. Table 2 provides an summary of the eight organizations in Ontario offering agriculture and food education, and also categorizes, and evaluates them based on their vision, activities, and resources.

Table 2: A Summary of Organizations in Ontario Educating Youth about Agriculture and Food

Organization	Food or Agriculture Focus?	Key Activity
AgScape	Agriculture	Resources for teachers to use in classrooms and the Teacher Ambassador Program
Durham Farm Connection	Agriculture	School Education Programs, Open House and Mobile Exhibit for events and fairs
Ecosource, Food in Schools	Food	Food in Schools Program
Everdale	Agriculture	Hands-On Learning Farm
Farm to Cafeteria, Canada	Food	Experiential Learning Program for schools
OFA Six by Sixteen	Food	Website – how to resources and recipes
Roots to Harvest	Food	Employment, Outreach and Education programs
Sustain Ontario's Edible Education Network	Food	Knowledge sharing between member organizations

To make this evaluation more effective, it would be useful to know the reach of their programs and resources. While it would be beneficial to know the number of learners in each

of the programs above, this is outside of the scope of this evaluation. Most organizations were very open about their human resources; However, their budgets were not always exposed.

From Table 2, it is easy to conclude that the majority of organizations in Ontario are focussing more on food literacy and its relationship with health, rather than agricultural literacy. Some organizations, such as the Ontario Edible Education Network and Farm to Cafeteria Canada serve solely as a platform for other organizations to connect and share knowledge, while other organizations work on the ground, directly with children and consumers. There are benefits and challenges to both of these approaches, however it is important that each type of organization exists to offer some type of non-formal agricultural and/or food educational activities. On its own, an organization that hosts information, but doesn't "do" outreach, would not effectively reach the targeted groups. Similarly, an organization that does outreach needs the tools, knowledge and information to educate consumers. The perspective taken in this study is that agriculture and food literacy are interrelated concepts. It would be ideal for more organizations to focus simultaneously on both types of literacy. Overall, these groups are taking a step in the right direction for agriculture and food literacy and have positively impacted the lives of youth across Ontario and Canada.

The following section will cover the agricultural literacy assessment of students.

Chapter 4: An Agricultural Literacy Assessment of High School Students in Ontario

Introduction

Once as an agrarian society, Ontario residents were knowledgeable about the agri-food sector. Over a century ago, the majority of people either lived on farms, or had very close family ties to a farm (Colbath & Morrish, 2010). Now, most of the population is two to three generations removed from agricultural production, and thus, know little about the origins of their food. In order to effectively create and improve agriculture and food literacy programs for youth, it is important to first understand what they already know about food and farming.

Research Context

As previously noted, much of the research in this discipline takes place in the United States. The studies that have been conducted on food and agricultural literacy often look at other demographic groups, such as parents, elementary-school young people, and post-secondary students. As far as is known, this study is the first of its kind in Ontario. It will be important to understand the level of knowledge high school students' have about agriculture currently, and identify gaps in their knowledge based on the assessments that have been conducted in the U.S. This way, programs can be better tailored to help this age group achieve agricultural literacy and understanding.

In the literature, it was inconclusive whether or not there was a difference in agricultural knowledge between urban and rural residents. Some studies found a large agricultural knowledge gap, supporting the "knowledge gap theory", while others indicated that there was no major difference between urban and rural consumers' knowledge. This research

seeks to add to the body of knowledge around this specific discussion. The demographic portion of the questionnaire asks students whether they consider themselves to be rural or urban residents. While it is unclear if being “rural” or “urban” has anything to do with one’s knowledge about agriculture, being involved in agriculturally-related activities (i.e. county fair boards, 4-H, Junior Farmers, etc.) might have more of an influence on the level of one’s agricultural literacy.

Additionally, this research will determine where the sample of high school students obtain most of their knowledge about agriculture and food. This will serve as the start to determining the outlets of information that should be of focus for the organizations “doing” agriculture and food education in Ontario. In addition to informing the organizations of the ways in which most information about agriculture has been communicated students, this research will also establish whether or not students wish to learn more about agriculture in the first place. This is important because if the students are not interested in learning more about this subject, the focus needs to be shifted to better understand what might motivate students to become more agriculturally literate.

Overall, this research seeks to fill gaps in the current body of knowledge about agriculture and food literacy. While the sample used in this section of the paper does not represent all high school students in Ontario, it sheds light on the level of knowledge this age group might have about agriculture. This research hopes to spark dialogue and discussion about the importance of agriculture and food education, and also inspire research in this field to be conducted in the future in Ontario.

Sample

As previously noted, this research takes place within a public school board district in the Greater Toronto Area (GTA). This school board was selected based on convenience and due to the limitation of time left to collect data. The region where the research was completed is home to both rural and urban communities, but predominately urban. It was settled as an agrarian society, however due to its proximity to Toronto, it has become one of the fastest growing regions in Ontario through urbanization. Much of the valuable farmland has been lost due to development, along with the agricultural knowledge of past generations of farm families.

This research occurs in two schools in the selected school board. Both are secondary schools, as the focus is on high school-aged students. High school students were selected as the concentration of this study because they are at an age of development where they are starting to, if not already, make more of their own decisions about food, and think more critically about society. Kraak & Pelletier (1998) acknowledge that youth are becoming consumers at younger and younger ages, and there are a number of experiences that shape their habits as consumers. Therefore, high school students are at a critical age to be learning about the agri-food system, as they will soon be independent consumers.

As the school board and specific schools asked not to be named, for the purpose of this research, they will be referred to as "School A", and "School B". School A is located in an urban area of the region. In the past couple decades, the population where this town is located has increased tremendously. School B is located in a more rural neighbourhood bringing in students from the country sides, as well as students from the town located nearby. Population

increases have not been as prominent in the boundaries of School B. School A is comprised of approximately 1500 students, while approximately 450 students embody school B. Thus, the more rural school is nearly one third of the size of the urban school. The total number of students in the overall secondary school board is over 18500 people.

First, approval of the research was given by the external research board of the school board. Once this was received, the principals of two chosen schools were contacted and met with to discuss the occurrence of this research. The two schools were chosen based on their proximity to each other, and also their population size – of both the student body, and the town of which they were located in. It was important to have one more-rural school, and one more-urban school so that the agricultural knowledge gap between urban and rural students could be more clearly evaluated. In the literature, most authors noted the effectiveness of using agriculture to teach *science*. Therefore, science classes in each of the schools were purposefully selected to participate. Each grade in secondary school is taught differently, however grade nine and ten (junior) are similar to one another, and grade eleven and twelve (senior) are similar to each other. Thus, it was decided that at least one junior science class, and one senior science class serve as samples from each school.

School A

In School A, the sample size is 49 students. The head of the science department contacted science teachers to determine who was interested in having their class participate. Teachers that volunteered to take part in the study determined the sample classes. The sample for this school was comprised of a grade nine science class of 18 students, a grade 11 university biology class of 12 students, and a grade 12 health science class of 19 students.

School B

In School B, the sample size was 39 students. The principal selected two science classes, based on convenience of both the school's schedule, and the research time line. They were also purposefully selected by the principal based on the criteria given by the investigator. One class that participated was a grade 10 open food science class of 14 participants, and the other was a grade 12 university biology class of 25 participants. The sample was smaller from School B than School A, because of the overall student population being smaller. It was important to include one extra class at School A to maintain thoroughness. In total, there were 88 complete survey responses.

Data Collection and Analyzation Methods

Collection Methods

Data was collected through the use of an online survey instrument in Qualtrics. The survey included 29 questions – both qualitative and quantitative questions, therefore taking a mixed methods approach (Appendix D). The first section of the survey focussed on demographic questions to determine what school the participant attended, what grade they were in, what community was nearest to where they live, how long they have lived there, and whether they live in an urban or rural area. Another important piece of background information about participants is their family involvement in agriculture, and their partaking in agriculturally-related activities. The next section evaluated their perceived level of agricultural literacy by inquiring about how much knowledge they felt they had about agriculture, and how comfortable they would be talking about agriculture. Food was the focus of the next section,

whereby participants were asked to agree or disagree 5 different statements using a 5-point Likert-type scale.

The next, and largest section of the survey, assessed participants' actual agricultural knowledge. The first two questions asked students to identify their familiarity with 8 different images. 4 of these images were of common crops grown in Ontario, and 4 of these images were of equipment used in modern farming. Participants were asked to identify the contents of the images they recognized and, if able, explain what it's use was. The next questions focussed on some of the controversial topics, commonly misunderstood and miscommunicated, in modern agriculture. The first of these topics addressed was genetically modified organisms (GMOs). Students' knowledge on this area was assessed through a series of statements with which they were to agree or disagree with. The next issue addressed was conventional vs. organic agriculture, and this was assessed through the same style of question, with a series of statements. Participants were then given 9 general statements about agriculture with which they were to say whether they think it is true or false. They were then asked to agree or disagree to three different statements regarding animal agriculture in Ontario, and finally, broadly state whether they feel the food they consume is safe. This concludes the agricultural literacy assessment portion of the research.

To meet the fourth research objective and determine where students get most of their information regarding agriculture and food, participants were asked to identify their main source(s) of information. They were then asked to recall a piece of media that relates to agriculture or food, and also, if able, name Ontario's local food promotion campaign.

Participants were asked to state whether or not they had ever met a farmer, rate their experience with this farmer, and identify the type of interaction with the farmer.

To conclude this section of the research, and meet objective five, four questions were asked to participants. It was asked if participants would like to learn more about agriculture and food, and if there was anything specific about this subject that they would like to know more about. To determine their interest and awareness of careers in the agri-food industry, participants were asked to agree or disagree to three statements related to this topic. The first statement being “I have considered a job in the agriculture and food sector”, the second being “there are few jobs in the agriculture sector”, and the third being “jobs in agriculture require manual labour and farming only”. To conclude the survey, an open-ended question was asked whereby students had the opportunity to comment on anything they would like about food and agriculture that may or may not have been addressed in this research.

Data Analysis

Data was analyzed by hand using cross-tabulations on Qualtrics and Excel. Cross-tabulations were generated within Qualtrics to compare several variables and then inputted by hand into Excel to be analyzed to determine percentages of the sample for each category. Most of the analysis involved comparing students that identified themselves as living in a rural or urban area. It was important to compare these variables rather than the schools because some students that attended the “rural” school live in an urban area, and vice versa with the “urban” school. Also, data analysis using these variables was done keeping in mind that students based their location of “rural” or “urban” based on their perception of what they consider to be rural or urban.

The following were the variables used in the cross-tabulations:

- Community nearest to where the participant lives, compared with the number of years they have lived there
- Grade participant is in, analyzed with questions related to food (e.g. help with grocery shopping, healthy eating habits, etc.)
- Involvement in agriculture of rural vs. urban students
- Perceptions of agricultural knowledge of rural vs. urban students
- Agriculture literacy assessment of rural vs. urban participants
- Information sources of rural vs. urban students
- Careers and interest in further learning about agriculture in rural vs. urban demographic groups

Once data was inputted onto Excel, proportions of the population were calculated for each finding to achieve research objectives. The following section outlines the findings from the data analysis.

Findings

Participant Demographics

First off, respondents were asked to identify the closest community to where they live and state the number of years they have resided there. This is represented in Table 3 below. Community A is where School A is located, and this is considered an urban area. Community B is the location of School B, and this along with Community C, D, E, and F are rural communities. The “other” communities were mainly rural. Each of the “rural” communities have suburban areas that students might have considered to be urban. The same can be said for Community A

– there are some rural areas within this town, therefore some students who selected Community A, said they were from a rural area. Therefore, moving forward, it is important to keep in mind that categorizing students as “rural” and “urban” is based on their *perceptions* of where they live.

Table 3: Community nearest to participant and the number of years they have resided there

Years	Community A	Community B	Community C	Community D	Community E	Community F	Other
0-5 years	17	2		1	1	1	
6-10 years	12	4					1
11-15 years	15	13	1			1	1
16 - 20 years	7	7				3	1

Interestingly, a low proportion of the student participants have resided in their home community for their whole life. The majority have recently moved to their community and have lived there for less than 10 years, but it is unknown what type of community they lived in prior. Table 4 illustrates the number of students at each school from urban or rural areas. All students that stated they were from an “other” area, stated “suburban” in the blank text box provided.

Table 4: Area of residence categorized by school

Area	Participants
School A	
Urban	35
Rural	9
Other	5
School B	
Urban	24
Rural	14
Other	1
Total	88

Food

As stated many times throughout this paper, food is a large component of agriculture education. To briefly determine the relationship participants have with food, a number of questions were asked in the survey. It was found that 66% of the total number of participants feel that they generally eat healthy food, while 16% disagreed with this statement. When asked to agree or disagree to “I generally make my own meals”, 44% of students agreed, while 37.5% disagreed, however 66% of participants stated that their meals are made for them most of the time. 18% of students said they do their own grocery shopping, with the majority of them being in grade 12. When asked if they “sometimes help with grocery shopping”, 77% of participants answered yes, while 20% do not.

Involvement in Agriculture

Participants were asked if their immediate family is directly involved in agriculture, and if so, they were asked to explain how. Results were similar between urban and rural students, with 15% of urban participants, and 17% of rural participants stating that their family is involved in agriculture. Four of the 14 participants stating that their family is involved in agriculture said that their Grandparents either have or had a farm, while another five participants said one of their parents’ farm or works in the agri-food sector. One student lives on a farm, two help out on their family’s farm, and one student has a vegetable garden at home. One participant has a sibling that goes to school for sustainable agriculture.

Many agriculture-related activities exist for youth, however there is a low number of students involved in them currently, therefore raising some questions that will be discussed further later. Only 2.3% of participants are involved in their local 4-H association, and 1.2% are

a member of Junior Farmers Association of Ontario. 23% of participants are involved in their local fall fair, with 80% of these students being from an urban area. 30% of students from a rural area are involved in an agriculture-related activity that was not listed and mentioned tractor pulling, school programs, volunteering, farm ambassador programs, or working on farms as their engagement. 40% of urban students and 44% of rural students stated they were involved in some sort of agriculture activity, representing no major difference. 84% of students located in a suburban area stated their involvement in an agricultural activity.

Agricultural Knowledge Perceptions

Participants were asked questions to determine their perception of their agricultural knowledge. Firstly, 13% of rural students stated that they feel very-extremely knowledgeable about agriculture, 50% feel moderately knowledgeable, and 35% feel unknowledgeable. Next, only 5% of urban students feel very-extremely knowledgeable about agriculture, 25% feel that they are moderately knowledgeable, and 70% feel that they are not knowledgeable when it comes to agricultural topics. When they were asked to rate their level of comfort when discussing or talking about agriculture, 39% of students who perceive themselves as rural stated that they would feel slightly-very comfortable talking about agriculture, and 43.5% feel slightly-very uncomfortable discussing agriculture. In comparison, 28.8% of students who perceive themselves as urban stated that they would feel comfortable talking about agriculture, while 57.6% of urban participants feel slightly-very uncomfortable talking about agriculture.

Agricultural Literacy Assessment

There is little difference between the agricultural knowledge of urban and rural students. The first question asked as part of the assessment was in regard to common crops

farmed in Ontario and Canada. Four images – soybeans, canola, wheat, and corn – were displayed in the survey and students were asked to label the ones they recognized. 21.7% of rural students, and 11.9% of urban students were able to correctly identify canola, 0% of rural students, and 1.7% of urban students were able to identify canola, 91.3% of rural students, and 95% of urban students were able to label corn correctly, and 87% of rural students, and 84.7% of urban students were able to recognize wheat. A similar question in regard to farming machinery was asked next. Again, results were scattered. 26% of rural students and 33.8% of urban students correctly identified a combine, 8.7% of rural participants and 6.8% of urban participants identified a sprayer, 65% of rural and 67.8% of urban students recognized a tractor, and 4.3% of rural participants and 3.4% of urban participants were familiar with the image of the planter.

The next set of questions assessed students' knowledge on GMOs. Participants were asked to agree or disagree to a number of statements. The first was "I know what a GMO is" – 87% of rural students, and 72.8% of urban students agreed, while 8.7% of rural students, and 16.9% said they "don't know". 47.8% rural, and 37.3% urban students feel that GMOs are safe to eat. Interestingly, when asked to respond to the statement "GMOs do not pose a risk to the environment", 78% of rural students disagreed, while 44% of urban students said they "don't know", and 40% disagreed. Similar results were apparent when participants responded to "GMOs are illegal in Canada" – 73.9% rural students disagreed, while 49% urban disagreed, and again, 44% of urban students weren't sure. When responding to "GMOs are nutritionally the same as conventional foods", for rural students, 21.7% "agreed", 56.5% "disagreed", and 21.6%

said they “don’t know”. Responses of urban students were 11.8% “agreed”, 33.9% “disagreed”, and 52.5% said they “don’t know”.

Organic and conventional agriculture was the next topic in the assessment. 52% of rural students, and 66.1% of urban students believe that organic foods are healthier, while 30.4% of rural students admitted to not knowing whether they are or aren’t. 69.5% of rural students, and 88% of urban students believe that organic agriculture does not use chemical inputs. Additionally, 65% of rural students, and 50.8% of urban students believe that conventional farms are larger than organic farms, while a large group – 26% rural, 30.5% urban – of students “don’t know”. In regard to organic animal agriculture, 47.8% of rural, and 50.8% of urban students believe antibiotics are not used, and similarly to the previous question, 30.4% of rural, and 35.6% of urban students “don’t know”. Results to the last question for this section are sporadic. When asked if students think “organic agriculture is more sustainable than conventional agriculture”, 30.4% of rural, and 25.4% of urban students said “yes”, 26.1% of rural, and 32.2% of urban students said “no”, and 39.1% of rural, and 40% of urban students said they “don’t know”.

Knowledge about animal agriculture was also evaluated. In response to “farmers take excellent care of their animals”, 30.4% of rural students, and 25% of urban students selected “agree”, while 47.8% of rural, and 40.7% of urban “disagreed”. When asked to respond to “farmers give their animals hormones to produce larger animals”, rural students’ responses were 52% agreed, 8.7% disagreed, and 34.8% weren’t sure, while for urban students, 69.6% agreed, 8.5% disagreed, and 22% weren’t sure. 43.5% of rural students, and 57.6% of urban

students stated that they think farmers give their animals antibiotics even when they are not sick, while 43.5% of rural participants, and 35.6% of urban participants said they were unsure.

In the general agriculture question section, results were consistent and there weren't major differences between the knowledge and opinions of rural and urban students. Results for this section are outlined in Table 5. Each question is written above the group of answers for rural and urban students. They were "true" or "false" questions based on their knowledge.

Table 5: Rural vs. Urban Knowledge of General Agriculture Topics

Agriculture impacts me daily		
	<i>Rural (% responses)</i>	<i>Urban (% responses)</i>
<i>True</i>	78	68
<i>False</i>	0	18
<i>Don't Know</i>	22	14
Food is a result of agricultural practices		
<i>True</i>	91.3	93
<i>False</i>	0	2
<i>Don't Know</i>	8.7	5
Clothing is a result of agricultural practices		
<i>True</i>	74	76
<i>False</i>	13	8.5
<i>Don't Know</i>	13	15.5
Fuel for cars can come from agriculture		
<i>True</i>	56.5	91.8
<i>False</i>	26	18.6
<i>Don't Know</i>	17.4	5
Antibiotics used in agriculture are in my food		
<i>True</i>	65	69
<i>False</i>	13	5
<i>Don't Know</i>	22	26
The number of farms in Canada has increased over the past 10 years		
<i>True</i>	17.4	91.8
<i>False</i>	56.5	18.6
<i>Don't Know</i>	26	5
All farmers are male		
<i>True</i>	0	1.7
<i>False</i>	95.7	93
<i>Don't Know</i>	4.3	5
All farmers are above the age of 30		
<i>True</i>	0	1.7
<i>False</i>	92.3	90
<i>Don't Know</i>	8.7	5

When students were asked if they feel the food they eat is safe, 60.8% of rural students, and 45.7% of urban students responded “yes”, 17.4% of rural students, and 11.9% of urban students responded “no”, and 21.7% of rural students and 40.7% of urban students responded that they weren’t sure. Additionally, they were asked if they knew what percentage of farms in Canada are family owned and operated, and only 1 student (urban) out of 88 answered correctly, 98%. 21.7% of rural students, and 16.9% of urban students answered 72%. The other commonly selected answer was 12% for this question – 43.5% of rural students, and 37.3% of urban students selected this option.

Information on Agriculture and Food

Participants were asked to identify the source(s) of their information regarding agriculture and food. 42% of all participants got most of their information about agriculture from TV, 35% from social media, 53% from the Internet, 41% from friends and family, 35% from Fall Fairs and community events, 13.6% from the newspaper, 50% from school, and 3% from other sources. This is represented in Figure 3.

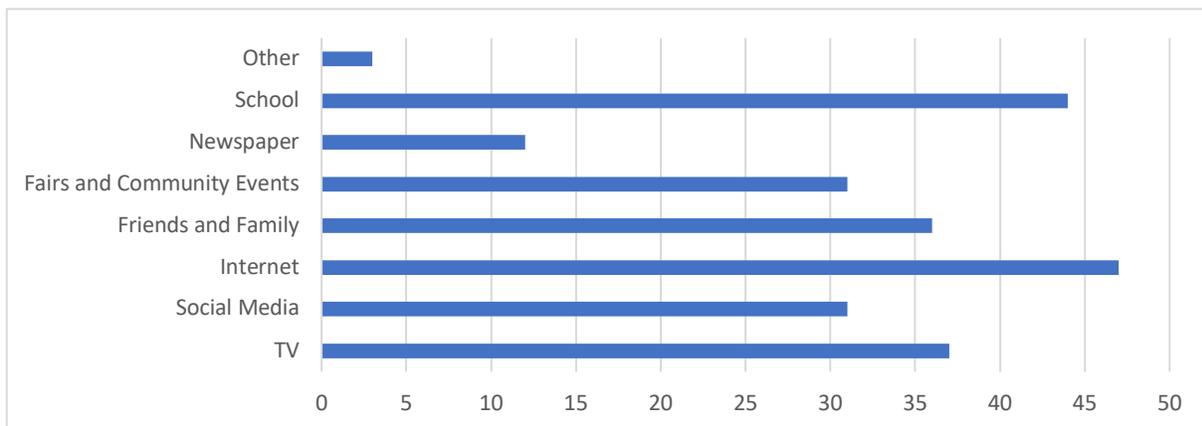


Figure 3: Agricultural Information Sources of Participants

Students were also asked to indicate whether or not they had met a farmer. 74% of students who perceived themselves as rural and 78% of students who perceive themselves as urban said they had met a farmer, while 100% of suburban students had met a farmer. Of the students that indicated they had met a farmer, 33% rated their experience as “excellent”, 43.5% said it was “good”, 21.7% rated their interaction as “average”, and only 1.5% said it was “poor”. This indicates that, generally, students’ experiences while interacting with farmers were positive. The nature of the interaction is represented in Figure 4 below.

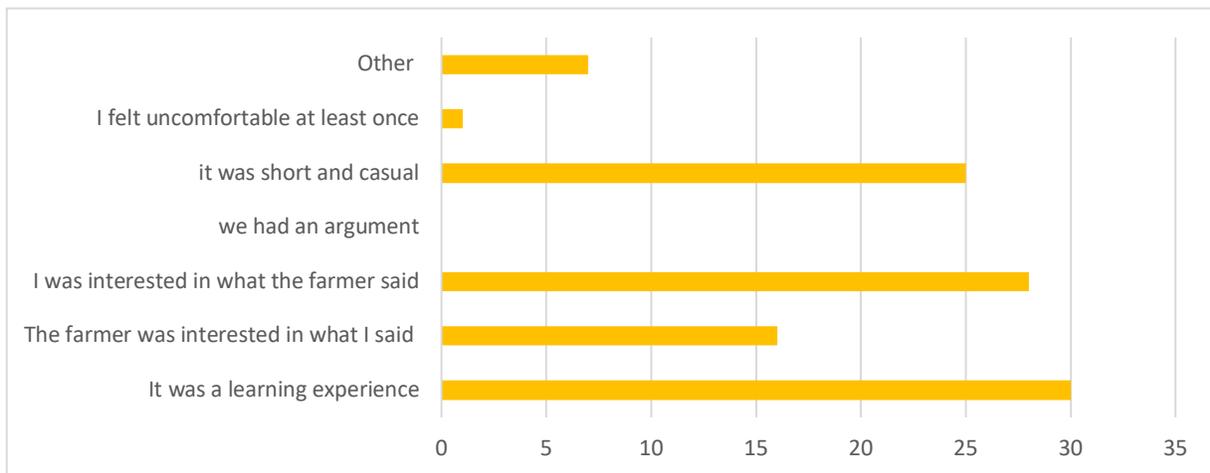


Figure 4: Type of Interaction between Participant and Farmer as perceived by Student

When asked to recall the name of Ontario’s local food promotion campaign, “good things grow in Ontario”, only 8 respondents overall had an idea of what was meant by this, and only 2 out of the 88 participants answered this question correctly. Instead, some students answered, “eat local”, or “Farmers Feed Cities”. Additionally, 43% of participants were able to identify a piece of media that relates to agriculture or food. Of these participants, many of them indicated they have seen documentaries on Netflix, videos on YouTube, Movies, social media posts, and news articles as the media they were familiar with related to agriculture and food. Among the familiar media are documentaries such as Food Inc., Cowspiracy, Just Eat It,

Super-Size Me, Forks Over Knives, The Meatrix, Bread Belly, and movies and TV shows including Charlotte's Web, Anne of Green Gables, Little House on the Prairie, National Geographic, Nanny McPhee, the Food Network, and Arthur. Participants also mentioned YouTube videos about GMOs, livestock farming, animal rights, veganism, etc., and commercials such as the one by Dairy Farmers of Ontario, and the "good things grow in Ontario" local food advertisement.

Agri-Food Careers and Further Learning

There are endless career opportunities in the agri-food sector, therefore it is important that students are aware of this. When asked if they have ever considered a job in the agriculture and food sector, 82% of participants said they had not, and only 13.6% of students said they had. Participants were also asked to agree or disagree to the statement "there are few jobs in the agri-food sector" – 25% agreed, 46.6% disagreed, and 28.4% said they weren't sure. Similarly, 28.4% of students were unsure of the nature of jobs in the industry – when they were asked to agree or disagree with "jobs in agriculture require manual labour and farming only", 6.8% agreed, and 64.7% disagreed, and were aware that not all jobs require physical skills and hard-labour.

Furthermore, participants were asked if they would like to learn more about food and agriculture – this is illustrated in Figure 5. 20% of participants answered, "definitely yes", 31.8% said "yes, some", 25% stated "maybe", 15.9% answered "not really", and 6.8% responded with "definitely not".

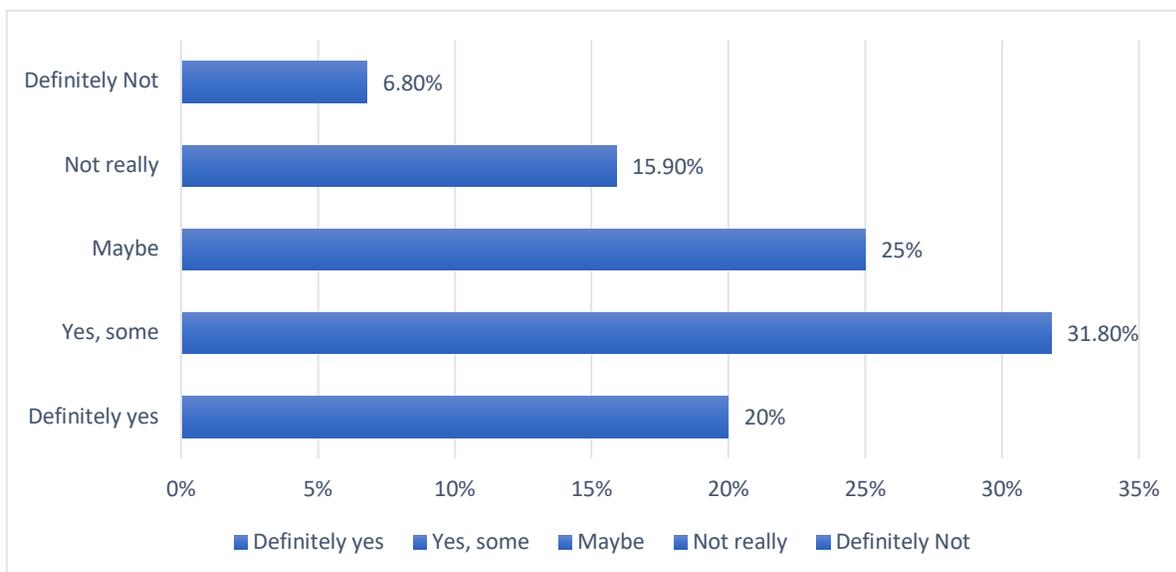


Figure 5: Participant responses to “would you like to learn more about food and agriculture?”

Participants also had the opportunity to comment on anything else about food and agriculture that they wanted, and specify what more, if anything, they would like to know about. Below are some of the participants’ responses in Table 6.

Table 6: Further Questions and Comments from Respondents

Is there anything else about food, agriculture and health that you would like to comment on?
Factory farms make people unhappy and uncomfortable, and I am happy to see them go. I appreciate Ontario farmers that treat their livestock well and would do my utmost to support especially family owned farms and sustainably produced produce.
I feel that it is greatly unappreciated and that there are many stereotypes concerning 'dumb farmers'.
Not a lot of people understand the lengths that farmers have to go to keep their land, and make sure they don't go into debt. Often farmers have to plan a year ahead to know if they will have enough money to get the seed they need, if the market of the crop will go down or up and what crops to invest in.
Food is much better organic and should not be taken away from modern day farming and technology. Traditional farming is better and has always been. It gets the job done.
It's all corrupt scheme for money, the food only gets worse and inflected with GMO's and pesticides, which then causes the people to get sick. In places like America where you have to pay for health, the food that made you sick is now profit for the hospitals. A corrupt world, scheming for money.
GMOs can cause diseases
I wish all food was organic, it would be so much better for the world and our bodies
How current day food, that are added with certain chemicals are affecting the human body.
Is there anything specific about agriculture and food production that you would like to know more about?
What are the long-term implications of eating GMOs
Health impacts of GMOs if there are any

What farming will most likely evolve into in the future
Mass farming operations
The governments opinions on agriculture and how it will be in the next generations
Does where you live have a massive impact on what you know about agriculture?
Is the food safe and how do we help if it is not?
I would like to understand more about animals and what goes into them and how it affects us
I would like to learn the basics of growing your own food in order to be able to sustain yourself.
The environmental effect of GMO's on surrounding wildlife and the treatment of the animals used in different brands of food.
Just know more about the process and what happens
Futures for family run businesses in agriculture and Monsanto's involvement regarding them.
Are there really any bad side effects of having genetically modified food?
How we can do it in our own backyards like making a garden, if antibiotics will end up hurting humans, how we can support farmers.
More about the types of farms
Farming practices
How farmers plan their years (buying seeds ahead of time, paying for the land, etc.)
Data regarding negative effects of GMO's both for crops and animal's
Not really, I just think it's really important and interesting, and I've always found farms to be really beautiful.
I would like to know more about animal production.
How to get work in agriculture, how much income you make per year working in agriculture
The inner workings of machines and how to make them more efficient or less energy wasting.
What is the difference between organic food and regular food
I don't know anything about it so all of it??
I'd be interested in learning about the bad side of agriculture. A look on how animals are treated poorly, and generally how farmers maintain their animals.
I would like to learn more about GMOs (3)
Are there jobs?
How to get involved?
Why is it that we seem to know so little?
Why are we not educated on agriculture?
How everything is made, processed into what we eat today.
More about the food production aspect of agriculture.
how it can affect someone's health whether it be organic or not? how it can affect human in a physical way?
I would like to know more about the production and processing of organic foods.
How animals are treated. More about how GMO isn't actually dangerous. More about how we can no longer naturally obtain vitamin B12 through the soil. More about organic versus regular produce.
mainly about the food production
How animals are farmed.
Everything
I sometimes wonder if I could learn how peppers, olives, watermelons, or pineapples grew.
what they use to make all their strawberries so red and big
is this business growing or shrinking?

is the food production in this process safe
Is there a specific time of the year when GMOs are planted? For the animals who are implanted with GMOs, are they certain to die What is the most dangerous type of GMO and does it go in any of our food
The way farmers mass produce crops and meats for certain animals. are the foods that I'm eating safe??
I want to know how the farmers treat the animals and if they give them anything bad so that the animal produces more products.

Many of these comments and questions are around the topics of GMOs, farm animal care and welfare, pesticides, organic vs. conventional farming, health, sustainability, family farms, and general farming operations. These responses will be further discussed below.

Discussion of Survey Results

This section discusses the results of the survey using the following themes: food, involvement, knowledge perceptions, agricultural literacy, information sources, and careers and further learning.

Food

The findings suggest that most participants don't have a strong relationship with their food. While all of them eat food each day, the majority of participants do not make their own meals and instead, someone else – likely a parent or guardian – makes meals for them. However, many students admitted to sometimes helping with the grocery shopping.

Involvement

The findings indicate that while 15% of urban participants, and 17% of rural participants stated they had family directly involved in farming, it is unclear exactly what knowledge comes from this experience. Not all students stated what type of farm this was, and of the one's that did, it is unclear whether or not they had any personal connection or experience with that farm. Furthermore, students that stated that their grandparents farm, further enforced the notion

that most people are two to three generations removed from agricultural production. What is also striking here was the number of students involved in the local fall fair – 80% of students that stated that they were involved in the fair were from an urban area. Therefore, based on these preliminary findings, location has no apparent influence on student involvement in agricultural activities of this nature.

Knowledge and Perceptions

Based on the findings, it appears that rurally located students are much more confident in their agricultural knowledge than urban students. For example, 13% rural vs. 5% urban students felt they were knowledgeable about agriculture. Twenty-five percent of urban students felt moderately knowledgeable, however 50% of participants feel moderately knowledgeable. The highest portion of urban students felt unknowledgeable, with 70%, and only 35% rural students feeling unknowledgeable. The same can be said about comfort in discussing or talking about agriculture-related subjects.

Agricultural Literacy

Overall, it appears that being “rural” or “urban” has no major influence on sample students’ agricultural literacy, according to these findings. For the question regarding participants’ knowledge of different crops, results were similar between rural and urban students. It is not shocking that most students were not able to correctly identify canola as it is not a commonly grown crop in Ontario and is not farmed near either of the schools. Few students were able to correctly label soybeans, however most students, both rural and urban, were able to correctly identify corn. It is unclear whether or not students know the difference between corn produced for human consumption and corn for livestock feed. Additionally,

there was no major difference in the knowledge about farm equipment between rural and urban students. Less than a third of students in each category (of rural and urban) were able to identify a combine. Many of their answers were not necessarily a “combine”, but instead a “harvester”, or at least described the use of a combine. A low number of participants recognized the sprayer and a planter. The largest portion of students were familiar with the image of a tractor.

Students appeared very unsure of their knowledge of GMOs and the effects they have on the environment and one’s health. Most students seemed to know that GMOs aren’t illegal in Canada, however there was still a large percentage that weren’t sure. It would have been beneficial to ask participants for their definition of GMOs to see if they truly knew what they were. Overall for this section, rural students seemed comparably more confident in their answers, as less of them said they “don’t know”. Agricultural literacy is especially important for improved decision making, especially in regard to making decisions about food purchases.

The debate between conventional and organically produced foods is widely misunderstood by consumers. More urban students than rural students believe organic foods are healthier than conventionally produced foods. Again, more urban students (88% urban vs. 69.5% rural) also believe that organic agriculture does not use any chemical inputs. Participants also generally believe that conventional farms are always larger than organic farms, however this is not always the case. Media might be a large influence on students’ perceptions of this topic. Similar to GMOs, students seem very “unsure” of their knowledge on organic agriculture. There are opportunities to teach these topics in many different disciplines such as geography, environmental studies, and science.

Based on these preliminary findings, it appears that popular media might be influential on students' knowledge of the way that farmers care for their animals. Many of the participants stated they felt that animals aren't cared for excellently by farmers, and those same students have also seen numerous of the existing documentaries that are against animal agriculture. Hormones and antibiotic use amongst animals is misunderstood by consumers, and this comes across in the findings with this sample. Again, there is no difference between the knowledge and opinions of urban and rural students.

In terms of the general questions about agriculture, results were inconsistent. For some questions, rural students appeared more agriculturally literate, and for others urban students rated higher. For the most part, students were aware that agriculture impacts them daily. More urban students than rural were mindful that fuel for cars can come from agriculture, as well as clothing. It is however, problematic that a large portion of participants believe that antibiotics used in animal agriculture are in their food. It is important students are made aware of food safety precautions before they become consumers. This will prevent them from falling for misleading labeling and marketing on the products they purchase once they become consumers themselves.

Almost all students were aware that men and women can be farmers, and not all farmers are above the age of 30. In fact, between 2011 and 2016, the proportion of farm operators under 35 years of age increased from 8.2% to 9.1% (Statistics Canada, 2017a). Additionally, "women account for an increasing share of farm operators, rising from 27.4% in 2011 to 28.7% in 2016" (Statistics Canada, 2017a, p. 4). Women farmers are most prevalent "among farm operators aged 35 to 54 years" (Statistics Canada, 2017a, p. 4). Only a small

percentage of students weren't sure of these questions, and few to none believed that all farmers are above 30 years old and are male. In Canada, 97% of farms are family owned and operated (Farm & Food Care, 2017), contrary to what students believe. Also, student participants, as previously mentioned, are about to become independent food buyers, however – based on the findings – many of them feel that the food they consume is unsafe. Social science, and careers classes would be a good place to include these general agriculture topics in their learning objectives. Results such as this might suggest that there are misunderstandings in these subjects, and signifies the importance of teaching them to students whom are about to become independent consumers.

Information Sources

Based on the findings, the largest number of students reported that they get most of their information regarding agriculture from the Internet, followed by school, then television or videos, friends and family, social media tied by fairs and community events, and lastly newspapers. Participants had the opportunity to select multiple options from this list which ensured a more wholesome, accurate answer. Fifty-three percent of respondents relying on information from the Internet is noteworthy, especially because anyone has the ability to put anything on the Internet – whether it be true or false. As previously mentioned, it would be beneficial to encourage media literacy and critical thinking so that students are able to decipher between correct and incorrect information on the Internet and other information sources.

What is also interesting, is the high number of students that stated they have met a farmer. When they were asked about the nature of the interaction, almost all of them stated their experience was positive, indicating that people might trust farmers as a reliable source of

information. Almost all participants were unable to recall Ontario's local food promotional jingle, "good things grow in Ontario". This is surprising seeing as this saying is played on many radio stations, and TV commercials. Participants' reliance on Netflix documentaries and YouTube videos as a source of information about agriculture is problematic. Most of the documentaries viewed by students – Food Inc., Cowspiracy, Supersize Me, The Meatrix – originate in the U.S. and are based on American agricultural systems.

Careers and Further Learning

A large portion of students had never considered a career in agriculture, which makes it appear as though they are unaware of the opportunities in the industry and are unsure how to get involved in the first place. This is where the role of the guidance counsellors come in - teachers and guidance counsellors have the ability to act as important, healthy role models for their students and have a positive influence on them (Korzun & Webb, 2014). They have the ability to make students aware of the jobs in the agri-food sector and can encourage students to learn more about this subject in various disciplines.

Additionally, many students are eager to learn more about agriculture, therefore they should be provided with more opportunities to explore its topics. This could take place both within and outside of the classroom. For example, school programs in and outside of classes, extra-curricular activities, and elective courses could be created to encourage agricultural literacy. Lastly, many of the questions and comments students raised in the open questions at the end of the survey can be easily addressed through simple learning initiatives.

Summary

Overall, rural students started off more confident than urban students in terms of their perceptions of their agricultural knowledge. After the assessment, it became apparent that one's location might not have a huge influence on one's knowledge of agriculture. In many cases, urban and rural students scored equally in the agricultural literacy assessment. At times, rural students scored higher, and at other times, urban students scored higher. Therefore, it cannot be concluded that rural students are more agriculturally literate based on this sample.

Also, a large majority of student participants expressed their interest in learning more about agriculture and food. While many of them gather information from the Internet and school, these prove as useful outlets agricultural programs can use as platforms. As mentioned, media literacy is another important component of high school students' learning, so that they can decipher between the true and false information they are presented with. Not only is there a need for students to learn about agriculture, there are also demands from participants for further learning. Chapter Five will cover an analysis of the Ontario high school curricula and identify where themes around agriculture, food, and farming are apparent.

Chapter 5: Agriculture in the Ontario High School Curricula

Introduction

This chapter explores formal agricultural education within the context of the Ontario High School Science Curricula. The analysis identifies where words such as “agriculture”, “food”, and “farm” appear in the science curricula and environmental education resource document by the Ontario Ministry of Education. Overall, there are many opportunities to include this topic in the courses taught to students.

High School Curricula in Ontario

“Agriculture is the oldest of the arts and the most recent of the sciences” (James, 1898). This is a quote derived from the introductory pages of C.C. James’ textbook titled *Agriculture*, published in 1898. This was the third textbook published in the subject and was intended for use in any High School or Public School in Ontario to aid students in acquiring knowledge of the science of agriculture (James, 1898). In the preface, James (1898) wrote

An intelligent understanding of the science underlying the art of agriculture will add much interest to what is otherwise hard work, and, as a natural consequence, the pleasure of such work may be greatly increased. The agriculturalists of this country in the future will work at a serious disadvantage if they do not have some knowledge of the very interesting science that underlies their work. The residents of our towns and cities also will find that some knowledge of the science of agriculture may be of use to them and may increase the respect and consideration for the calling that contributes so largely to the general wealth and welfare of this country (p. iv).

Even historically it was noted that learning about agriculture is important for both those involved directly in agricultural practices, and those from urban areas that don’t have an intentional role in the industry. From the early days of education in Ontario, agriculture was embedded heavily in the Ontario high school curriculum (Woltz, 1914). This chapter seeks to

identify themes around agriculture and food as they exist in the current high school curriculum in Ontario. The curriculum policy documents that were used for this section exist to “identify what students must know and be able to do at the end of every grade or course in every subject in Ontario publicly funded schools” (Ontario Ministry of Agriculture, 2017). Along with the Secondary Curriculum, the Ontario Ministry of Education has other relevant policy and resource documents including *Environmental Education: Scope and Sequence of Expectations*, developed in 2017, amongst many others.

As previously noted in the review of literature, there is a major opportunity to teach agriculture through the science curriculum. Therefore, the following research will analyze the Ontario Secondary Science Curricula to determine where words such as “agriculture”, “agricultural”, “farm”, and “food” are currently present. While many other key words are related to agriculture and food education, for the purpose of this research, the words mentioned are of particular focus. The *Environmental Education: Scope and Sequence of Expectations* resource will also be analyzed to identify where agricultural literacy is encouraged. Understanding where in the science curricula themes around agriculture are, will determine where gaps exist so that recommendations can be made. Following the curricula analysis, will be a discussion of findings.

Findings

The table in Appendix E shows the areas where key words, including “agriculture”, “farm”, “agricultural”, and “food” appear in the Ontario High School Curricula. The *Environmental Education: Scope and Sequence of Expectations* Resource is used by teachers as a guideline to recommend where they might be able to encourage learning about

The chart below (Figure 7) summarizes the table in Appendix B by illustrating the number of pages each key word appears on in each of the curricula. “Frequency” is the number of the times the term occurs on a page.

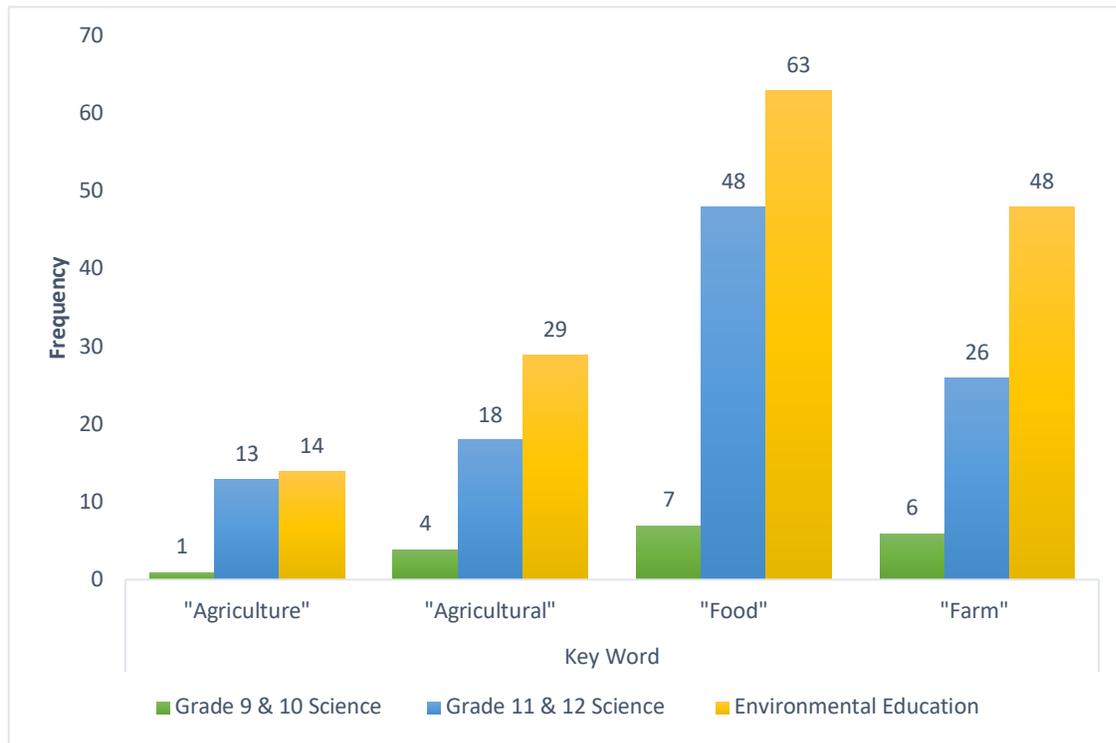


Figure 7: Frequency of Key Words in Curricula

In the Grade 9 and 10 Science Curriculum, the word “agriculture” appears on one page, “agricultural” appears on four pages, “food” appears on seven pages, and “farm” appears on six pages. These numbers are considerably lower than the occurrence of the key words in the other two curricula documents. In the Grade 11 and 12 Science Curriculum, the word “agriculture” appears on 13 pages, the word “agricultural” appears on 18 pages, the word “food” appears on 48 pages, and the word “farm” appears on 26 pages. Finally, in the Environmental Education Resource, “agriculture” emerges on 14 pages, “agricultural” on 29 pages, “food” on 63 pages, and “farm” on 48 pages. “Food” is the most commonly appearing

key word in all curricula, and the Environmental Education Resource contains the most “key words” throughout, in comparison to the other two documents. While it is indirect, the curricula contain numerous recommendations for secondary students to learn about agriculture and food through science.

Discussion of Curricula Review Results

Through analysis of the curricula it is apparent that the Ontario Ministry of Education includes multiple objectives and suggestions for students’ learning about agriculture, food, and farming. As noted, the Grade 9 and 10 Science Curriculum contains the least amount of agricultural education learning objectives. Students in grade 9 and 10 are between the ages of 14 and 16. The word “agriculture” is only found once throughout the grade 9 and 10 curriculum and “agricultural” only 4 times. “Food” comes up the most in this curriculum by appearing on 7 pages, followed by “farm” appearing on 6 pages. This is problematic because the areas that do include these key words are only suggestions. Many of the excerpts are only *sample issues or sample questions*. The teachers using these guidelines are not required to use these specific sample questions or issues, therefore there might actually be no inclusion of agriculture themes at all. Also, where “food” appears, it might actually have no relation to food production, or agriculture at all. For example, grade 9 students in academic science are expected to be able to “analyse the effect of human activity on the populations of terrestrial and aquatic ecosystems by interpreting data and generating graphs”, and one of the examples for illustrating this is by examining the “suburban developments and their impact on the food supply for animals such as foxes and racoons” (Ontario Ministry of Education, 2008b). This

learning objective is not related to agriculture or food production or processing in any way. Therefore, it is not directly encouraging food or agricultural literacy.

It is fitting that there are more references to agriculture and food in the Environmental Education Resource as these are two very related subjects (Ontario Ministry of Education, 2017). As recognized by many authors including Hubert et al., (2007) environmental education is important in order to understand its interrelated systems including agriculture. This curriculum document included the high number of pages including each of the key words. Again, the most commonly occurring word throughout this resource was “food”, followed by “farm”, then “agricultural”, and lastly “agriculture”. Many of the excerpts from this curriculum document are directly related to concepts of agricultural literacy. What is also interesting about this document, is that many of the suggestions for learning about agriculture, food, and farming are tied into other courses in High School aside from science. The Environmental Education Resource includes suggestions for teaching about the environment in subjects including Arts, Business, Canadian and World Studies, International Languages, French, Health and Physical Education, Social Sciences and Humanities, and Technological Education (Ontario Ministry of Education, 2017). The study of the environment and agriculture have a role in many other areas of our society, and this is reflected through this document.

In the preface, the Ontario Ministry of Education (2017) explained that this document identifies the learning expectations in the curriculum that relate to, or provide opportunities for, environmental education. Educators in every discipline can use it to inform program planning, in order to take advantage of opportunities to support students’ development of related skills and knowledge (p. 3).

It is also stated in the preface of the document,

this policy framework emphasizes the necessity of ensuring that young people become environmentally active and responsible citizens. Students need to have the knowledge and skills that will enable them to understand and deal with complex issue that affect the environment now and in the future (p. 2-3).

They emphasize the need for students to develop skills in problem solving, decision making, action planning, and critical literacy, as well as “identify issues and perspectives, carry out research, and communicate their ideas in meaningful ways” (Ontario Ministry of Education, 2017, p. 3). The need for environmental education and agricultural education through this resource is extremely important, however this “scope and sequence document” is used by teachers as a support tool for incorporating these themes into other curricula. It is not required for them to include all of these components, and as previously mentioned, most of the key words appear in “teacher prompts” or “sample questions”, teachers are not required to include all of the recommended material.

The Grade 11 and 12 Science Curriculum has 13 pages that contain the word “agriculture”, 18 contain “agricultural”, 48 contain “food”, and 26 contain “farm” (Ontario Ministry of Education, 2008a). Students in grade 11 and 12 are between the ages of 16 and 18. They are at the prime age to be learning about agriculture and food, as they are the nearest to becoming independent consumers. Also important for students to learn about in grade 11 and 12 are the many career opportunities in the agri-food sector of Ontario. In a study by the University of Guelph, it was found that there are “four jobs for every graduate of the University of Guelph’s Ontario Agricultural College (OAC)” (University of Guelph, 2017). It also states that students do not need to have grown up on a farm to work in the agri-food sector, and careers in the sector are available in urban centres as well (University of Guelph, 2017). Therefore, due to the many opportunities in the agri-food sector, it is extremely important that students are

made aware and have the chance to learn about this subject and the possibilities in its sector. However, there was little mention about the career opportunities in the agri-food industry throughout these curricula. Incorporating more information about jobs in agriculture might help to address unemployment and provide the industry with more qualified, educated individuals.

Another important point that was confirmed throughout the literature review as well, is the issue around teacher accountability and the lack of agricultural knowledge of teachers. There are references to agriculture, food, and farming, and teachers are expected to teach these subjects and help students reach specific learning objectives. However, oftentimes, teachers don't possess the confidence in their knowledge of agriculture to teach this material. There is also the possibility that what they do know about the subject comes from the media, which could be an inaccurate representation of today's agri-food industry. Kornelson (2010) also found in her Ontario-based study that teachers sometimes felt uncomfortable or had a lack of interest in agriculture and food-related content. Thus, teachers potentially omit instruction about agriculture altogether, or they teach false information, contributing to increased belief in myths and misconceptions. There is a strong disconnect between the curricula and teachers, and they need to possess thorough knowledge of each subject in order to be able to teach it. As also noted by Kornelson (2010) is the lack of curriculum support for educators and creating more support for teachers would help to address this disconnect.

Moreover, an issue is the time constraint felt by teachers when trying to fit the entire curriculum into the school year. Teachers feel pressure of curriculum expectations, and the curriculum priorities are elsewhere (Kornelson, 2010). Therefore, agriculture and food topics

get pushed aside as they are encouraged to focus on other areas throughout course curricula. What is beneficial, is that there is freedom for educators to incorporate various material into the curricula. However, Kornelson (2010) notes that “while curriculum does include food and agricultural topics in expectations across various disciplines, the freedom that exists for educators to approach these topics in their own ways, means that a certain standard of engagement for students cannot be guaranteed” (p. 100). Providing more support to teachers to help them identify where they can incorporate agricultural topics, and also offering suggestions for ways to teach these topics in the most engaging way for students, might also help to address this issue.

Summary

While historically there was strong support for teaching of agriculture in Ontario secondary schools, it is clear the same level of encouragement for agricultural literacy does not currently exist. There are few references to agriculture, food, and farming lessons within the grade 9 and 10 science curriculum, more in the grade 11 and 12 science curriculum, and many in the environmental education resource. However, many of the references to these ‘key words’ are merely suggestions, prompts, or sample questions and issues, and the teacher following the curricula has freedom in the ways they teach science, and what specific lessons they choose to include. The Environmental Education resource is useful across a variety of disciplines and serves to benefit all teachers as a guide – if they so choose to use it.

Educators are not required to incorporate all suggested lessons, nor do they have the capacity and time to do so. While it might not be possible to implement a specific course on agriculture throughout Ontario, it would be beneficial to have sections in the curricula

dedicated to agriculture and food education. It has been noted by authors in the literature that using agricultural concepts as a medium to teach science is both effective, and beneficial for students. By using real-life examples – e.g. farming methods, plant growth, etc. – students are able to visualize and relate more strongly to scientific material. This will ensure that they are able to gain skills needed to think critically about science and communicate what is learned.

Again, with the curricula being tight as it is, it might be difficult to incorporate any more information than is already included. Another solution to ensure youth are educated about agriculture and food, is through programming outside of the classroom but still within secondary schools. Many schools have seen success in school gardens. Notably, Korzun et al. (2014) wrote that incorporating school gardens into schools improves academic performance and social relations; students have better relationships with the environment, are overall more engaged in their learning, and are more enthusiastic and aware in school. Getting young people involved and engaged in their food before they become independent consumers will increase their agricultural literacy and can bring enormous benefits for both the youth, and society.

More opportunities should exist within the Ontario secondary school curricula for students to learn about agriculture and food. There are numerous avenues whereby agriculture can be taught through the science curricula, and the environmental education document notes various ways to teach it in disciplines outside of science. It is a matter of ensuring teachers are agriculturally literate themselves and are equipped with the knowledge and confidence to be able to teach agriculture and food lessons. If they are unable to

incorporate learning objectives and particular concepts included in the curricula about these subjects, it is important the schools, school boards, and other organizations support educators.

Chapter 6: Final Summary, Conclusions and Recommendations

Final Summary

This paper has offered a brief, but important contribution to the subject of agricultural education. To reiterate, the central argument of this paper was that agriculture and food education is necessary to prevent public misunderstanding of the sector, improve health and well-being, and increase informed decision-making amongst young people who are about to become independent consumers. Agricultural literacy is defined in this paper as a person who has “an understanding of the food and fiber system that includes its history and current economic, social, and environmental significance” (Kovar & Ball, 2013, p. 168). Agricultural literacy is a complex subject and should especially encompass components about being able to critically analyze the media, summarize information they see or read, and have the ability to communicate it effectively and efficiently to others. This chapter will bring us back to the original goal and objectives of this research. The sections of the overall paper will be briefly summarized, and then main conclusions and findings will be discussed. This section will conclude with recommendations for policy, programming, and future research.

The goal of this research was to grasp a better understanding of agricultural literacy and education in Ontario. This research was intended to understand the perceptions and thoughts of high school students in Ontario regarding agriculture, distinguish whether or not there is a difference between rural and urban students knowledge about agriculture, determine where students get most of their information about agriculture, find out if students wish to learn more about agriculture and if they would consider careers in the industry, and identify where the Ontario secondary school curricula include themes about agriculture, food, and farming.

Firstly, to recap, this research took place in Ontario – specifically, the primary data collection took place in the GTA. The affects of urbanization and increased population are heavily felt here, and many people in this region are at least one to two generations removed from agricultural production (Statistics Canada, 2011). Jones (2011) explained in her work that “increased modernization and urbanization has created a disconnect between the population and agriculture” (p. 2). It is important that this gap between the population and agriculture be bridged, and agricultural education and literacy efforts are proposed as a solution to this.

The literature review uncovered the narratives and findings of researchers that have studied related topics. One of the common suggestions confirmed throughout the literature was the need to educate teachers about agriculture. Teachers have a unique role, and have the potential to heavily influence agricultural education. It is important they are better equipped and have the support they need to teach their students about this subject. They noted that it is beneficial to teach science through food and agriculture, as it better engages students. By teaching science through gardening programs or cooking, students will not only learn more about science, but they will also be equipped with practical skills that can be used in their everyday lives – such as having the ability to grow, harvest, and prepare food.

The differences between education *about* agriculture, and education *in* agriculture were also discussed. There are many opportunities for students to explore vocational agriculture – *education in agriculture*. However, many of these opportunities only exist within rural areas, or as post-secondary institutions. Therefore, urban populations often lack opportunities to learn about agriculture, and therefore risk becoming agriculturally illiterate. Authors urged for students in all grades in all areas to be provided with increased and equal access to learning

about agriculture and food (Anderson et al., 2014; Baker et al., 2010; Colbath & Morrish, 2010; Frick et al., 1995; Hubert et al., 2000; Kovar & Ball, 2013; Ontario Federation of Agriculture, 2017; and Kornelson, 2010).

It was argued in the literature that students should be encouraged to learn about food and making healthy choices through the formal education curricula (Baker & Rabinowicz, 2010). The literature suggests that learning about food while students are still in school can assist in reducing the rates of obesity among young people, and among adults living in poverty, because many of them rely on heavily processed food from the industrialized food system. OFA (2017) found that many people that took part in their survey had a weak relationship with the food they consume, and had little conception of Ontario's local food systems. As the world's population continues to increase, people are becoming progressively concerned about having an adequate food supply, therefore increased attention should be paid to preserving valuable farmland (Brinkley, 2012), and this could be aided with agricultural education efforts.

Next, eight organizations in Ontario that currently offer agriculture and food education to young people were evaluated and discussed. The criteria for this research, was that the organization had to target young people between the ages of four and 18, they had to have some sort of education, outreach, programming, or resources, and they were required to involve food, farming, or agriculture. Of these eight organizations, five of them were food focussed, and three of them were agriculture focussed. Details such as their vision, mission, key activities, and website were stated. What served as a limitation to this section, was that the reach and effectiveness of each organization could not be determined exactly.

Chapter Four covered the agricultural literacy assessment. The results of this section serve as a baseline of information about high school students in Ontario so that programs and policies can be better tailored to suit the needs of young people. This section tested the “knowledge gap theory”, which was mentioned by Specht et al. (2013), by challenging the knowledge differences between “urban” and “rural” students. The survey instrument covered the following components: demographic information, food, involvement in agriculture, knowledge perceptions, agricultural literacy assessment, and information sources. This method of data collection was inspired by various assessments of agricultural education in the U.S. It focussed on high school students because they were often overlooked in previous assessments, however they are an important age group as they are about to become consumers themselves, and also enter into the labour market and attend post secondary schools.

The final section covered an analysis of the Ontario high school curricula – specifically, the science curricula for grade 9 and 10, 11 and 12, and the Environmental Education supplementation document. Science was the focus of the curricula analysis as many of the authors in the literature review noted the effectiveness of teaching science through agriculture and food. Overall, it was found that food was the most commonly occurring word throughout all curricula documents, followed by farm, and then agriculture. These results were discussed and some of the pathways for curricula improvement were noted. All in all, more opportunities and support should exist to enable teachers to teach, and students to learn about agriculture.

Main Conclusions

Overall, the study appears to support the need for agriculture and food education of young people. There are many existing organizations in Ontario that offer agriculture or food

education programs and resources, however the focus of most of them is on food. It would be beneficial to have more programs that give stronger attention to agriculture, or both agriculture and food as a combined concept. Students should have the opportunity to learn how food is produced, and it's process before it gets to their plate. Experiential learning programs are noted as an effective way to educate young people, therefore it would be beneficial if organizations offered more hands-on learning opportunities.

In the assessment, a few key points came across throughout the analysis. When participants were asked about their relationship with food, students appeared to have a weak relationship with it, similar to the findings of OFA (2017). They weren't overly engaged in their food choices or meals. The majority of students stated that they did not have family directly involved in agriculture, therefore enforcing the notion that most people in society are at least one to two generations removed from agricultural production (Statistics Canada, 2011). This certainly has an impact on their overall agricultural knowledge and literacy as made clear in the assessment.

When asked to describe the perceptions they held about their agricultural knowledge, students located in rural areas were more positive, comfortable, and confident in speaking about agricultural subjects. Students located in urban areas appeared to be less confident in their agricultural knowledge. Interestingly, during the agricultural literacy assessment, the difference in knowledge between rural and urban varied throughout, and was nearly equal. It cannot be concluded that rural populations are more knowledgeable about agriculture than urban populations, however being involved in agriculture or having family ties to food production might be more of an influencing factor in one's knowledge. Students overall were

very “unsure” about various agricultural topics – specifically GMOS, hormones, antibiotics, and the difference between organic and conventional crops. Animal agriculture is also incredibly misunderstood. Much of students’ knowledge might be based on false, distorted, U.S.-based information from documentataries on Netflix such as Food Inc. and Cowspiracy. This is concerning, as it enforces and echoes the many myths and misconceptions about agriculture and farming. With agriculture not being correctly understood in this regard, consumers will lack confidence and information to make informed deicions about the foods they purchase and consume.

In terms of general agricultural information and knowledge, not all students are aware of the importance of agriculture in their everyday lives and the impact it has on their overall well-being. This is why it is so important to teach agriculture through a variety of disciplines to showcase how many areas of their lives are impacted by agriculture on the daily. Additionally, many participants feel that their food is unsafe. This is problematic seeing as they are about to become consumers themselves and should be able to trust the food system and know that what they are purchasing is, indeed, safe.

As the results indicate, most students get their information about agriculture from the Internet. Media literacy should be considered as an important component of agricultural education, and also other topics and disciplines. Also interesting, was that many students expressed that they had met a farmer and almost all of them had stated that they had a positive interaction with them and learned something from it. Experiential learning programs are useful because they could encourage farmer-student interactions which puts a “face to the issue” , and leads to a deeper, more complete understanding.

The majority of students conveyed that they had not ever considered a career in agriculture and were not aware of the many opportunities in the agri-food sector. This could be due to a variety of factors, one of which will be discussed in the recommendations section. Overall, the data informed that students are eager to learn more about agriculture and many of them raised questions about common myths and misconceptions.

Based on this preliminary study, it was found that the sample of high school students were not agriculturally literate. There might be a slight difference in knowledge of urban and rural residents, however where students resided might not have had a major influence on the amount of knowledge they held about agriculture. Involvement in agricultural activities or family ties to agriculture were likely more influential on the agricultural knowledge of students.

In the curricula assessment, many themes around agriculture, food, and farming were apparent. While there are numerous pages that include these key words, many of them are merely suggestions for lessons, or sample questions or issues that can be used to showcase a specific learning objective. The Ontario high school curricula is reliant on the teachers to include these specific components in their lesson plans. Most references to the key words involved in the research were located in the environmental education document. There is an opportunity to include agriculture in many different disciplines, however teacher support should be improved so that they feel confident doing so and are aware how and where agriculture can be taught.

Recommendations for Policy, Programs and Future Research

There are some key points that will be addressed as recommendations for policy, programs and future research. Firstly, it has become apparent that there is a need for

agriculture and food education in schools. While it might not be possible to develop a specific course for agriculture exclusively, it might be feasible to create a curriculum resource document similar to the *environmental education* resource, dedicated specifically to agriculture. This could show teachers where they can include agriculture in all disciplines, and serve as support for them teaching these topics. It would also be advantageous if Canada or Ontario were to develop a framework for agricultural literacy, similar to the FFSL framework that was crafted by the U.S. National Research Council in 1988. Canada does not have a national policy for including agriculture in the curriculum. The Food and Fiber Systems Literacy Framework (FFSL) in the U.S. urged institutions to include agriculture in their curricula – therefore, schools in the U.S. are incorporating it and have classes and programs dedicated specifically to learning about agriculture. Some institutions teach agriculture at the post-secondary level, and some high school have a *Specialist High Schools Major* program in Agriculture. Students have to choose to take these courses or programs, but do not have any input on what they learn in the general curriculum. Implementing something similar to the FFSL to include agriculture in curricula, would guarantee that all students are equal in learning about agriculture, and would ensure students meet specific objectives and expectations at certain points in their lives.

In terms of programs for agricultural education, as mentioned, more organizations should focus on agriculture *and* food learning as combined subjectives; they are connected because they are interdependent. This would be beneficial to help students grasp the links between their food and farming. Additionally, and as discussed, experiential learning has proven to be very valuable and is proposed as an excellent medium for agricultural education. Bevan (2016) notes that a dairy farm tour for an agricultural literacy class in a university made

students more understanding of farming and food production. Therefore, more programs should take this experiential approach, as it has the potential to be effective when used for agricultural education of young people.

As mentioned in this research, Woltz (1914) spoke about the first Normal School in Toronto, Ontario that opened in 1847 to train teachers in various subjects, notably, in agriculture. Teachers are obvious influencers of students' learning and they are given freedom to decide the methods and mediums they teach information from the curricula. Anderson et al. (2014) discussed the Oregon Summer Agriculture Institute (SAI), which is used as teacher training in the summer months. They found that teachers became more agriculturally literate through the program, especially those teachers that had limited knowledge of agriculture prior to their enrolment in this program (Anderson et al., 2014). Teacher training in agriculture could prove to be a very favorable tool. It would make teachers more confident in agriculture-related material, and point out the many avenues that agricultural topics can be taught – in disciplines besides science. Overall, there is a need for more teacher support to help improve agriculture and food learning. Assisting teachers in obtaining a better understanding of the agri-food system is a step in the right direction towards agricultural literacy of young people.

In terms of future research, there are a few specific topics to address. Firstly, not only should more students be assessed on their level of agricultural literacy, but also teachers, guidance counsellors, and other influencers. Their agricultural literacy and understandings should be determined to ensure they are equipped with the proper information to relay to students and those they are role models for. For example, many students go to guidance counsellors to help determine the courses they take and path they follow for their career goals.

It should be explored whether or not they are aware of the opportunities in the agri-food sector and if they suggest them to students as a career-path to look to.

In conclusion, this research sheds light on the importance of agriculture and food education in the context of Ontario. While this is a preliminary study, it presents an opportunity for further research to be conducted on the subject to inform educational policy and curricula as well as organizational programs outside the formal school system.

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Appendices

Appendix A: Original Research Design Matrix

Problem statement (in brief): consumers are questioning where their food comes from and are unable to make informed decisions about their food choices due to misinformation		
The goal of the study/project is: to understand what high school students know about agriculture		
Objectives (of the study/project)	Research Questions	Source(s) of Data, Selected Methods and Sampling Technique and Size
Objective 1: to understand student's perceptions of agriculture and their perception of their agricultural literacy level	1.1 What do students think of agriculture? 1.2 Do students think they are agriculturally literate? 1.3 How much do students think they know about agriculture?	- Survey - Students in High Schools in Halton Region
Objective 2: to evaluate students actual level of agricultural literacy	2.1 What do students know about modern agricultural methods? 2.2 Do they know how their food is produced and processed?	- Mixed methods – survey and interviews - Agricultural Education Assessment tool (TBD)
Objective 3: to determine where students receive information about agriculture and how this impacts their agricultural literacy	3.1 Where do students get information about agriculture? 3.2 what do they learn about agriculture in school? 3.3 what do they think about the way ag is portrayed in the media? 3.4 how does the media shape their opinion about agriculture?	- Surveys, and short answer questions

Appendix B: Revised Research Design Matrix

<p>Problem statement (in brief): Today’s youth are unaware of the origins of their food, and are therefore unable to make healthy and informed decisions about the food they will soon be purchasing and consuming once they become independent consumers.</p>		
<p>Conceptual/analytical framework (in brief): Knowledge gap theory – there is a gap in knowledge between people located in urban and rural areas. People directly involved in agriculture are more knowledgeable about agriculture and food production, as people in urban areas have fewer opportunities to learn about it.</p>		
<p>The goal of the study/project is: This research seeks to grasp a better understanding of agricultural literacy and education in Ontario and contribute to the existing body of knowledge on agricultural education in Canada.</p>		
<p>Objectives (of the study/project)</p>	<p>Research Questions</p>	<p>Source(s) of Data, Selected Methods and Sampling Technique and Size</p>
<p>Objective 1: To identify the organizations that currently exist in Ontario that work towards helping youth achieve agriculture and/or food literacy.</p>	<p>1.1 What organizations currently exist that offer agricultural education to youth? 1.2 What is the effectiveness of these organizations?</p>	<p>Organization websites – gathering information about vision, mission, key activities, etc. 8-10 organizations in Ontario</p>
<p>Objective 2: To understand perceptions, knowledge and information sources of high school students regarding agriculture and determine whether they wish to learn more or not.</p>	<p>2.1 What perceptions do students hold about agriculture, and how knowledgeable do they think they are? 2.2 is there a difference in agricultural knowledge of rural and urban students? 2.3 Where do students get most of their information regarding agriculture and food? 2.4 Do students wish to learn more about agriculture and do they consider careers in ag?</p>	<p>High school students in the GTA – 2 schools in a given school board – one rural, one more urban 2-3 classrooms at each school – science classes Survey instrument based on studies conducted in the U.S.</p>
<p>Objective 3: To identify where the Ontario secondary school curricula include themes and suggestions for learning about agriculture and food.</p>	<p>3.1 How many pages do the words “agriculture”, “farm”, and “food” appear on in curricula? 3.2 What is the nature and context of these words?</p>	<p>Curriculum analysis – science curricula and environmental education document</p>

Appendix C: Inventory of Organizations in Ontario offering Non-Formal Agriculture and Food Education

1) **AgScape, Milton ON** (www.agscape.ca)

Agriculture in the Classroom Canada is a not-for-profit organization that operates across the country. Currently, nine provinces have their own member organizations that are committed to serving as the voice of the nation in their individual province. Ontario's voice of Agriculture in the classroom is AgScape.

Vision

The vision of AgScape is to provide “factual, balanced, curriculum-linked food literacy programs and resources to Ontario’s educators and students” (AgScape, 2018).

Focus

AgScape focusses on agriculture and food education in the classroom through a variety of mediums. AgScape (2018) explains they do this because the “lack of consumer knowledge about food and farming systems is a contributing factor to the economic challenges facing Ontario’s agri-food industry”, “educating students about food and farming can help dispel myths, create a deeper interest and connection to food, and promote local (Canadian) food”, and finally, because “agriculture is currently not recognized as a separate subject within the Ontario curriculum”.

Key Activities

Their key methods to deliver information to students are with creative programming to expand the profile of Ontario’s agri-food sector by connecting food, farming, and health; by collaborating with partners to “deliver education programming that excites students and

teachers, and encompass all food production systems in Ontario”; and by connecting classrooms with “agri-food perspectives that increase understanding, encourage critical thinking, and stimulate dialogue” (AgScape, 2018).

Resources & Programs

AgScape delivers information and food, farming, and health to students through a variety of programs and resources. They have a place on their website dedicated to these free resources that reflect their values and ensure a balanced presentation of current, accurate facts (AgScape, 2018). Downloadable resources are specific to each grade through 1 to 12 and can be filtered by subjects as well. AgScape also has a teacher ambassador program whereby teachers can request an Ontario Certified Teacher to deliver an interactive lesson that aligns with the curriculum about a topic about agriculture, food, health, or the environment (AgScape, 2018). They also promote Canadian Ag Literacy Month throughout March, and have a program called “Agri- Trekking Across Ontario” for grades 4-6, and 7-8 (AgScape, 2018). AgScape promotes careers in the agriculture and food industries through their “growing careers” initiative, and also has a program called “All About Food” where lessons are given about various topics to encourage consumers, teachers and students to have constructive discussion about the agri-food system (AgScape, 2018).

Summary

AgScape has many useful resources that act as a catalyst for agriculture education in Ontario for students of all ages. They recognize that it is difficult for teachers to deliver information on these topics and fit it into the curriculum, therefore their teacher ambassador

program is especially important in helping to disseminate this information to students in the classroom.

2) Durham Farm Connections (www.durhamfarmconnections.ca)

Vision

Durham Farm Connections (DFC) was established in 2006 in Durham Region – which is a county located in the GTA, as previously mentioned. DFC “provides agricultural education opportunities for farm and non-farm communities in Durham Region to ensure the viability of the agriculture sector” (Durham Farm Connections, 2018).

Focus

Durham Farm Connections (2018) is operated by a group of passionate volunteers that are industry stakeholders or agricultural producers that have a vested interest in agricultural education. Beginning with a curriculum-based grade three program, DFC offers many opportunities to the communities based in Durham to learn about how local farmers help put food on their plates (Durham Farm Connections, 2018).

Key Activities

Several programs and activities are available through Durham Farm Connections. They have a high school program, an open house, and are also present at local fairs and events. Education programs are tailored to specific grades and align with the school curriculum (Durham Farm Connections, 2018). Students learn about food through hands-on activities from the people that produce it – the farmers (Durham Farm Connections, 2018). They also host an Open House whereby residents of Durham Region are invited to learn about agriculture through stations – “including meeting with farmers and livestock; as well as learning about

dairy, beef, pork, poultry, sheep, land stewardship, vegetables, apples and crops” (Durham Farm Connections, 2018). This free event is an opportunity for families to meet farmers from the area, as well as their animals, and learn about how crops are grown and where their food comes from (Durham Farm Connection, 2018).

Durham Farm Connection also offers a Grade 3 program, which is a single event held annually and is hosted by the volunteer farmers and educators. Students that attend this program rotate through 8 agriculture-themed stations that include hands-on demonstrations and live animal displays (Durham Farm Connections, 2018). The program is aligned with the Grade 3 Science, Health, and Social Studies Curriculums (Durham Farm Connections, 2018). Finally, the DFC has a mobile exhibit that features beautiful displays, activities, and ideas to help people learn about farming and the source of food and fibre (Durham Farm Connections, 2018). It is used at school and community events, festivals and county fairs across Ontario (Durham Farm Connections, 2018).

Resources

Durham Farm Connection’s main resources are their educational trailer, and their website. The real resource that cannot be “downloaded” or taken home is the volunteer time of farmers to their events and classroom programs. It is so valuable that students get to learn from local farmers about how their food is produced.

Summary

Durham Farm Connections does a great job at delivering educational programs to youth and providing opportunities for the public to learn about agriculture and food. Through their curriculum-based programs, their Open House, the Grade 3 program, and DFC’s mobile exhibit,

all operated by real farmers, people get hands-on experience with agriculture to better their literacy and understanding of the subject.

3) Ecosource (www.ecosource.ca)

Vision

Ecosource's mission is to "inspire and empower the community to become more environmentally responsible through creative public education" (Ecosource, 2018).

Focus

Ecosource is based in the Region of Peel – part of the GTA – and they work in schools throughout the community to deliver "interactive learning experiences that inspire youth and adults to take actions that make a huge difference to the health of the planet" (Ecosource, 2018). They highlight ways in which adult and youth in the community can increase their environmental responsibility, including "waste reduction, urban agriculture, community gardens, youth environmental leadership, and local food" (Nelson et al., 2013).

Key Activities

Ecosource has developed various innovative ways to teach community members, including youth, to be more environmentally responsible and accountable (Nelson et al., 2013). Their waste reduction programs include waste reduction workshops, and school field trips to teach students about waste and ways they can reduce the amount of food and products they waste (Ecosource, 2018). Ecosource has created a number of local food programs including a community gardens program in partnership with the city of Mississauga, and The Community Roots project as part of the Sustainable Urban Agriculture project (Ecosource, 2018). They offer

a large range of garden workshops and training programs, as well as school workshops and garden trips, and school field trips (Ecosource, 2018).

They also have a Food in Schools program, and they find that “when participants in the food chain are engaged and better understand the impacts of their food choices, they are passionate about wanting to make informed food choices that benefit the environment and their local community” (Ecosource, 2018). Under the Food in Schools program, they have several projects, such as the Alternative Avenues project, where they addressed local food procurement through student and teacher-led food programs, student and school-led cafeteria programs, and student nutrition programs (Ecosource, 2018). Another project under this program is the Cafeteria Connects project where cafeteria staff were trained on tracking, preparing and communicating local food options (Ecosource, 2018). They celebrated produce and farmers from the Durham Region and held workshops to include food education in the business, hospitality and family studies curriculums (Ecosource, 2018). This program was also host to the School Food Action Coalition, and the Cooking Up Action! Culinary Challenge (Ecosource, 2018).

Resources

Ecosource has a multitude of resources on their website that can be used as information sources for teaching and training, and also as inspiration for duplication of projects.

Summary

Ecosource offers several programs that increase opportunities for residents of Peel to connect with nature, learn through hands-on experiences, and understand their impact on and the relationship with the local food system, which has helped improve the health of their

communities. Their Food in Schools program is especially notable for improving the food literacy of youth in schools, and also engaging youth in the community.

4) Everdale (www.everdale.org)

Everdale is a farm based in Hillsburgh, Ontario.

Vision

Everdale's mission is to "be a farm-based organization that provides hands-on, solution-based food and farming education to build and engage healthy local communities" (Everdale, 2018).

Focus

Everdale delivers "a wide range of hands-on learning programs on food and farming to people of all ages and backgrounds" (Everdale, 2018). The three main pillars they operate under are production farm, farmer training, and school programs (Everdale, 2018).

Key Activities

Everdale is a production farm, as well as a learning farm. They sell their produce at Farmer's Markets throughout Toronto and in counties surrounding their home farm in Wellington (Everdale, 2018). They also run a 200-member year-round Harvest Share program and have weekly pickups in Toronto and Hillsburgh (Everdale, 2018). They host a Farmer Training program to educate youth and other community members about and in agriculture (Everdale, 2018). Under this program, is the Farm Planner project, which is a 7 session course that focusses on equipping people with the skills to develop a farm plan and ensure their business is successful (Everdale, 2018). They also provide a Sustainable Farming Certificate program where their "students" can gain on-farm experience and curriculum-based training

throughout the season (Everdale, 2018). For people that are looking to learn more about gardening or focus on a specific skill, Everdale offers one day workshops to help people improve different practical skills (Everdale, 2018).

Finally, Everdale (2018) offers a number of curriculum-linked school programs:

- Flock Fun: Grades K-6
- Near and Natural: Grades 4-12
- Market Garden Magic: Grades 1-3
- Soil Detectives: Grades 1-3
- Farmer for a Day: Grades K-12
- Field Work on the Farm: Grades 9-12
- Biological Farming: Grades 7-12

These school programs are aimed to help students develop environmental and agricultural literacy and stewardship (Everdale, 2018). As an extension of this program, they offer a Farm Camp for young people to enroll in throughout the summer and further their experience on the farm and make a meaningful connection with nature and the outdoors (Everdale, 2018).

Resources

They have no informational “take home” resources on their website, however the main resource for knowledge comes from the hands-on experiences one gains on the farm.

Summary

Everdale offers a number of opportunities for youth of all ages to learn about agriculture and how to grow their food. Hands-on opportunities are so important, as it has been proven that youth learn more when the environment is experiential, and they are engaged.

5) Farm to Cafeteria Canada (www.farmtocafeteriacanada.ca)

Vision

Farm to Cafeteria Canada (F2CC) is a Canada-wide organization that has a vision for “vibrant and sustainable regional food systems that supports the health of people place and planet” (Farm to Cafeteria Canada, 2018).

Focus

F2CC works with “partners across Canada to educate, build capacity, strengthen partnerships, and influence policy to bring local, healthy, and sustainable foods into all public institutions” (Farm to Cafeteria Canada, 2018).

Key Activities

F2CC works with partner organizations to “secure funds to establish and evaluate promising F2C practices with a view to informing policy” (Farm to Cafeteria Canada, 2018). They maintain an e-platform to share knowledge information and resources with members (Farm to Cafeteria Canada, 2018). Also part of the organization’s dialogue, is Farm to School, Farm to Campus, and Farm to Healthcare (Farm to Cafeteria Canada, 2018). Their focus is the Farm to School program, where they collaborate with partners in school settings to get high quality foods on the “minds and on the plates” of those who consume them (Farm to Cafeteria Canada, 2018). This program seeks to address “social, economic, and environmental determinants that contribute to poor eating habits among Canadian students” (Farm to Cafeteria Canada, 2018). The Farm to School: Canada Digs In! programs are based in elementary, middle, and secondary schools, and campus settings (Farm to Cafeteria Canada, 2018). The activities in this program are designed to “improve student nutrition and food literacy while strengthening the local food system” (Farm to Cafeteria Canada, 2018). The activities included in this program include developing, implementing and evaluating

experiential food education activities (i.e. school gardens), developing and implementing food procurement policy, and providing a salad bar food service featuring vegetables and fruits (Farm to Cafeteria Canada, 2018).

Resources

The F2CC website features a variety of fact sheets, guides, evaluation documents, videos, articles, and infographics about the benefits of Farm to School (Farm to Cafeteria Canada, 2018).

Summary

Farm to Cafeteria Canada is a national organization that does work across the country. Their programs are adaptable in any type of school – elementary, middle, and secondary schools, as well as university and college campuses. This allows the program to have a wide reach and helps to improve food literacy of youth across Canada.

6) Ontario Federation of Agriculture's (OFA) Six by Sixteen, Ontario

(www.sixbysixteen.me)

Vision

The Ontario Federation of Agriculture's (OFA) Six by Sixteen program seeks to improve food literacy by ensuring that the next generation is able to make healthy, nutritious food choices.

Focus

Six by Sixteen focusses on helping “young people learn to plan and prepare six nutritious, locally sourced by the time they are sixteen years old” (OFA, 2018).

Key Activities

OFA (2018) outlines what food literacy is, why it is important, and equips parents and teachers with different ways to teach children and students about making healthy food choices. Their website is broken down into three sections to help young people improve their food literacy. The first is a “*learn* how to cook section” where children can learn different skills such as how to peel a hard-boiled egg, how to roast a turkey, how to chop an onion, or many other skills using quick and easy videos (OFA, 2018). The next section teaches young people where to “*find* local food” by pointing them in the direction of farmers markets, pick-your-own farms, and commodity products such as pork, honey, berries, eggs, and poultry in grocery stores or other outlets (OFA, 2018). The final section equips young people with ways to “make healthy food choices” by teaching them when fruits and vegetables are in season in Ontario, giving them reasons to buy local, and how to read nutrition facts and Canada’s Food Guide (OFA, 2018).

Resources

As of right now, Six by Sixteen’s main resource is their website. This website is promoted to parents, teachers, and children at fairs and public events, and through social media.

Summary

Six by Sixteen has enormous potential to be a useful program for improving the food literacy of youth. Learning food skills at a young age has proven to be very beneficial. In the future, this program would become more useful if it were promoted and utilized in classrooms, or in conjunctions with projects of other organizations.

7) Roots to Harvest (www.rootstoharvest.org)

Vision

Roots to Harvest “provides transformative educational and employment opportunities for youth to engage with local agriculture and cultivate healthy communities (Roots to Harvest, 2018). They have a vision “of a future where youth are leaders, connecting a diverse community and cultivating food that’s healthy and accessible” (Roots to Harvest, 2018).

Focus

Roots to Harvest has programs that operate under three pillars; employment, outreach, and education (Roots to Harvest, 2018). This organization is based in Northern Ontario, in Thunder Bay.

Key Activities

Roots to Harvest’s (2018) Employment program

provides employment skills training to young people and adults who are invested in increasing their employability in an environment that promotes community engagement and partnership, hard work, and core employment skills enhancement. Participants are not required to have agricultural experience to participate and will be immersed in and contribute to a community of people focused on food security, community building, and urban agriculture, in an environment that promotes personal support, and political awareness.

Roots to Harvest’s (2018) Outreach program “engages with various communities throughout Thunder Bay using food and growing as common denominators”. Through adult education and employment skills training programs, cooking programs and grocery store tours enhance the “knowledge and skills of adults” to “further the quality of their lives and increase their social determinants of health” (Roots to Harvest, 2018). Across the city, there are gardening and agricultural tool libraries to help improve food security actions and make community and backyard gardens more accessible to everyone (Roots to Harvest, 2018).

Finally, Roots to Harvest's (2018) Education programs are provided to local schools. These programs are delivered through "cooking programs in Foods classrooms, cultivating school gardens with students, and providing freshly prepared, regionally sourced school meals to students" (Roots to Harvest, 2018). These educational programs are geared towards young people of all ages, between grade 1 to 12 (Roots to Harvest, 2018).

Resources

The Roots to Harvest website serves as their main location for resources and information on their programs and activities.

Summary

Roots to Harvest has tremendous potential to grow and expand their programs. They invest in their youth and students, and provide them with hands-on, meaningful opportunities that appear to have a major influence on their lives.

8) Sustain Ontario's, Ontario Edible Education Network (www.sustainontario.com)

Vision

Sustain Ontario is the "alliance for healthy food and farming" (Sustain Ontario, 2018). They have recently begun a network called the Ontario Edible Education Network (OEEN). Its vision is to "have health food environments across Ontario where children and youth have equal access to healthy and sustainably produced food, and where food literacy is supported through a range of educational and hands-on activities" (Sustain Ontario, 2018).

Focus

The Edible Education Network brings together groups that connect children and youth with food such as teachers, farmers, student nutrition providers, parents, non-profit

organizations, school boards, administrators, administrators, young people, public health, food businesses, etc. (Sustain Ontario, 2018). They seek to “help people teach students about good food practices (e.g. growing, preparing, cooking) that will improve their well-being now and, in the future,” and also assist the network in affecting “processes and decisions within government and elsewhere that influence opportunities for people to build healthy food environments across Ontario” (Sustain Ontario, 2018).

Key Activities

The key activities of the Ontario Edible Education Network are 1) information, resource, and knowledge sharing; 2) mentorship program development; 3) advocacy; 4) capacity building; 5) workshops and training; and 6) community engagement (Sustain Ontario, 2018). Nelson, Korzun, Maksimowski & Salt (2013) state that the OEEN “supports those who work with children and youth by providing inspiration, motivation and resources” (p. 35). They have connected over 100 groups that have the common goal of improving food literacy amongst youth (Nelson et al., 2013).

Resources

The OEEN website is full of various resources. It includes information about food in the curriculum, food education outside of the curriculum, how to engage children using school and community food gardens, resources about food skills and cooking programs, student nutrition programs, and local and sustainable food in schools (Sustain Ontario, 2018). Resources range from success profiles, fact sheets, infographics, teaching tools, external website links, action plans, etc. (Sustain Ontario, 2018). They assist in hosting webinars on various topics regarding food literacy, have a blog, and answer common questions that are useful for the network.

Appendix D: Survey instrument

An Agricultural Literacy Assessment of High School Students in Ontario

This survey is administered by Christine Wilkinson, the research investigator, at the University of Guelph. The purpose of this survey is to gather information about the agricultural literacy levels of high school students in Ontario. I will use the study results for a Major Research Paper, which is my final graduation requirement. My hope is that the study will contribute to a better understanding of how the agricultural community can engage more effectively with the public, especially young people. If you have questions regarding your rights and welfare as a research participant in this study (REB# 17-07-029), please contact: Director, Research Ethics, University of Guelph; reb@uoguelph.ca; (519)-824-4120 (ext. 56606). Please note that confidentiality cannot be guaranteed while data are in transit over the internet. You do not waive any legal rights by agreeing to take part in this study. This project has been reviewed by the Research Ethics Board for compliance with the federal guidelines for research involving human participants. Individuals responsible for this study who can be contacted for further information are as follows:

Christine Wilkinson Student Researcher,
University of Guelph, School of Environmental Design & Rural Development

Dr. Helen Hambly Associate Professor,
University of Guelph, School of Environmental Design & Rural Development

This survey should take approximately 20 to 30 minutes to complete. The eligible participants are grade 9, 10, 11 or 12 students in the selected school board. This survey is part of a study that has been reviewed and cleared by the University of Guelph's Research Ethics Board. The REB protocol number associated with this survey is REB# 17-07-029.

Having read the above, I understand that by clicking the "yes" button below, I agree to take part in this study under the terms and conditions outlined in the accompanying letter of information. By clicking "yes" your answers will be entered into the study. You may opt to quit the survey at any time. If you complete the survey, however, your name and contact information will remain confidential and your contact will not be linked to any of your survey answers. You have also been provided with a hard copy of the consent information in the event that you are not able to print it.

Yes (1)

No (2)

Q1 Which high school do you go to?

▼School A (1) ... School B (2)

Q2 What grade are you in?

Grade 9 (1)

Grade 10 (2)

Grade 11 (3)

Grade 12 (4)

Q3 What community is nearest to where you live?

(1) – (7)

Q4 Do you live in a rural or urban area?

Rural (1)

Urban (2)

Other (3) _____

Q5 How many years have you lived in this community? (Number only)

▼1 (1) ... 20 (20)

Q6 How knowledgeable are you about agriculture?

Extremely knowledgeable (29)

Very knowledgeable (30)

Moderately knowledgeable (31)

Slightly knowledgeable (32)

Not knowledgeable at all (33)

Q7 How comfortable would you be if you were asked to discuss or talk about agriculture?

Very comfortable (1)

Moderately comfortable (2)

Slightly comfortable (3)

Neither comfortable nor uncomfortable (4)

Slightly uncomfortable (5)

Moderately uncomfortable (6)

Very uncomfortable (7)

Q8 If you are involved in any of the following agriculture-related activities, please check the relevant box. For any other related activity please indicate "other" and list the activity.

- 4-H (1)
- Junior Farmers (2)
- Fall Fair (3)
- Plowing (4)
- Food for Thought Initiatives (5)
- Other (6) _____
- Other (7) _____

Q9 Is your immediate family currently involved in agriculture? If yes, please describe how.

Yes (1) _____

No (2)

Q10 Agree or disagree with the following statements:

	Strongly agree (25)	Somewhat agree (26)	Neither agree nor disagree (27)	Somewhat disagree (28)	Strongly disagree (29)
I generally eat healthy food (1)					
I generally make my own meals (2)					
My meals are generally made for me (3)					
I generally do my own grocery shopping (4)					
I sometimes help with grocery shopping (5)					

Q11 Do you have any of the following special dietary needs or preferences? If you have any other special dietary need indicate "other" and list that need.

- Vegan (2)
- Vegetarian (3)
- Gluten-free (4)
- Lactose-free (5)
- Other (6) _____

Q12 Which crops (pictured below) are you familiar with? Please label the crop beside the image and in the same space write a food product that is made from that crop.

- Image:Soybean (1) _____
- Image:Canola (2) _____
- Image:Corn (3) _____
- Image:Wheat (4) _____
- I don't recognize any of these crops (5) _____

Q13 Which pieces of farming equipment (pictured below) are you familiar with? Please label the machinery beside each image you recognize and explain what you think it's purpose is.

- Image:Combine (1) _____
- Image:Sprayer (2) _____
- Image:Tractor (3) _____
- Image:Planter (4) _____
- I don't recognize any of this machinery (5) _____

Q14 Please indicate which statements about Genetically Modified Organisms (GMO Foods) are true.

	Agree (13)	Disagree (14)	Don't Know (15)
I know what a GMO is (1)			
GMOs are safe to eat (2)			
GMOs do not pose a risk to the environment (3)			
GMOs are illegal in Canada (4)			
GMOs are common in many of the foods I eat (5)			
GMOs are nutritionally the same as conventional foods (6)			
I have seen "GMO" on food labels (7)			

Q15 What do you think is the difference between conventional and organic agriculture? Please explain.

	Yes (21)	No (22)	Don't Know (23)
Organic foods are healthier (1)			
Organic foods cost more (2)			
Organic crops do not use chemical inputs (3)			
Conventional farms are larger than organic farms (4)			
Antibiotics are not used in organic animal agriculture (5)			
Organic agriculture is more sustainable than conventional agriculture (6)			

Q16 What percentage of farms in Canada do you think are family owned and operated?

- 98% (1)
- 72% (2)
- 56% (3)
- 12% (4)
- 5% (5)
- I'm not sure (7)

Q17 Indicate if the following statements are true or false.

	True (17)	False (18)	Don't Know (19)
Agriculture impacts me daily (1)			
Food is a result of agricultural practices (3)			
Clothing is a result of agricultural practices (4)			
Fuel for cars can come from agriculture (6)			
Antibiotics used in agriculture are in my food (7)			
Food in Canada is affordable (8)			
The number of farms in Canada has increased over the past 10 years (9)			
All farmers are male (10)			
All farmers are above the age of 30 (11)			

Q18 How do you perceive animal agriculture in Ontario (livestock farming)?

	Agree (11)	Disagree (12)	Not Sure (14)
Farmers take excellent care of their animals (1)			
Farmers give their animals hormones to produce larger animals (3)			
Farmers give their animals antibiotics even when they are not sick (4)			

Q19 Do you think the food you eat is safe?

- Yes (1)
- No (2)
- Not sure (3)

Q20 Agree or disagree with the following statements as they're related to agriculture careers

	Agree (1)	Disagree (2)	Not sure (3)
I have considered a job in the agriculture and food sector (1)			
There are few jobs in the agriculture sector (2)			
Jobs in agriculture require manual labour and farming only (3)			

Q21 Where would you say you get most of your information about agriculture?

- TV (1)
- Social media (Facebook, Twitter, Instagram, etc.) (2)
- Internet (3)
- Friends & Family (4)
- Fairs & community events (5)
- Newspaper (6)
- School (7)
- Other (8) _____

Q22 Can you recall a piece of media (a book, movie, documentary, YouTube video, social media post, etc.) that relates to agriculture or food? Please write down all agriculturally-related media you have seen, read, or heard. If you haven't seen any media that relates to agriculture, write "none".

Q23 What is the name of Ontario's local food promotion campaign (do not say this out loud or share your answer with other students). If you can't recall or name a local food campaign, write "none".

Q24 Would you like to learn more about food and agriculture?

- Definitely yes (1)
- Yes, some (2)
- Maybe (3)
- Not really (4)
- Definitely not (5)

Q25 Is there anything specific about agriculture and food production that you would like to know more about?

Q26 Have you met a farmer?

Yes (1)

No (2)

Q27 You indicated that you have met a farmer, how was your experience when you last met with the farmer?

Excellent (11)

Good (12)

Average (13)

Poor (14)

Terrible (15)

Q28 What type of interaction did you have when you last met with the farmer?

It was a learning experience for me (1)

The farmer was interested in what I said or asked (2)

I was interested in what the farmer said (3)

We had an argument (4)

It was short and casual (5)

At least once during the interaction I felt uncomfortable (6)

Other (7) _____

Q29 Is there anything else about food, agriculture and health that you would like to comment on?

Thank you for your participation in this survey!

Appendix E: Detailed summary of key word findings in the Ontario High School Curricula

Grade	Curriculum Subject	Unit/Focus	Key Word	Text in Curriculum
Grade 9	Science	Physics: The Characteristics of Electricity	Agriculture	“ <i>Sample issue:</i> The operation of wind farms along Lake Huron produces electricity from a renewable source, reducing dependence on non-renewable sources of electricity. However, the wind farms produce noise and visual pollution, affect local animal life, and reduce the amount of land available for agriculture.” (p. 54)
Grade 9	Science - Academic	Biology: Sustainable Ecosystems	Farm	“Evaluate the effectiveness of government initiatives in Canada (federal, provincial, municipal), and/or the efforts of societal groups or non-governmental organizations, such as Aboriginal communities, environmental groups, or student organizations, with respect to an environmental issue that affects the sustainability of terrestrial or aquatic ecosystems (e.g., wetland restoration, recycling programs, Canada–Ontario Environmental Farm Plans, stewardship of national and provincial parks)” (p. 48)
Grade 9	Science - Applied	Biology: Sustainable Ecosystems and Human Activity	Farm	“Sample question - What action has been taken to green the grounds of your school? What effect has such action had on the local ecosystem? What additional action could be taken? What local initiatives have been developed to reduce the amount of pollution released into nearby rivers or lakes? What additional initiatives could be taken to enhance the sustainability of these ecosystems? How has the implementation of an Environmental Farm Plan (EFP) changed practices at a local farm? What are the benefits of the plan with regard to the sustainability of the ecosystem?” (p. 60)
Grade 9	Science – Applied	Biology: Sustainable Ecosystems and Human Activity	Farm	“identify some factors related to human activity that have an impact on ecosystems (e.g., the use of fertilizers and pesticides; altered shorelines; organic and conventional farming; urban sprawl), and explain how these factors affect the equilibrium and survival of populations in terrestrial and aquatic ecosystems (e.g., fertilizers change the fertility of soil, affecting what types of plants can grow in it; pesticides leach into water systems,

				affecting water quality and aquatic life; shoreline development affects the types of aquatic life and terrestrial vegetation that can live by lake shores or river banks; urban sprawl wipes out fields and woods, destroying wildlife habitats” (p. 61)
Grade 10	Science – Applied	Earth & Space Science: Earth’s Dynamic Climate	Farm	“Analyze, on the basis of research, various ways in which living things and natural systems have been affected by climate change (e.g., the effect of loss of permafrost on northern roads and housing; the effect of longer growing seasons in some regions on farmers; the effect of warming oceans on coral reefs), and communicate their findings” (p. 88)
Grade 9	Science – Academic	Chemistry: Atoms, Elements, and Compounds	Agricultural	<i>Sample Question:</i> “How does the widespread use of agricultural chemicals in Canada or elsewhere effect the economy, society, and the environment?” (p. 52)
Grade 9	Science – Academic	Earth and Space Science: The Study of the Universe	Agricultural	Expectations – Understanding Basic Concepts: “Describe various reasons that humankind has had for studying space (e.g. to develop calendars for agricultural purposes, to forecast weather, for celestial navigation, for religious inspiration) and the conceptions of the universe held by various cultures and civilizations (e.g. Aboriginal peoples; ancient Greek, Mayan civilizations)” (p. 55)
Grade 10	Science – Applied	Earth and Space Science: Earth’s Dynamic Climate	Agricultural	<i>Sample Issue:</i> “Some areas of Canada have been experiencing hotter and drier summers, resulting in poor harvests, loss of wetland habitat, and increased incidence of forest fires. However, in other areas, and increase in the number of frost-free days has extended the agricultural growing season” (p. 90)
Grade 9	Science – Academic	Biology: Sustainable Ecosystems	Food	Expectations – Developing Skills of Investigation and Communication: “analyse the effect of human activity on the populations of terrestrial and aquatic ecosystems by interpreting data and generating graphs (e.g., data from Statistics Canada, Parks Canada, and other websites on: the concentration in water of chemicals from fertilizer run-off and their effect

				on the growth of algae; stressors associated with human use of natural areas, such as trampled vegetation, wildlife mortality from motor vehicles, and the removal of plants, animals, and/or natural objects; suburban developments and their impact on the food supply for animals such as foxes and racoons” (p. 51)
Grade 10	Science – Academic	Physics: Light and Geometric Optics	Food	<i>Sample questions:</i> “How do vision sensors help the Canadian Food Inspection Agency improve food safety? How are photonics used in the early diagnosis of diseases such as cancer?” (p. 80)
Grade 10	Science – Applied	Biology: Tissues, Organs, and Systems	Food	Expectations – Relating Science to Technology, Society, and the Environment: “evaluate the effects that use of or exposure to a technology, substance, or environmental factor (e.g., cellphones, X-rays, UV radiation, personal audio players, cigarette smoke, pesticides, food additives/preservatives, vitamins, gene therapy) may have on the function of human tissues, organs, or systems” (p. 86)
Grade 10	Science - Applied	Earth and Space Science: Earth’s Dynamic Climate	Food	Expectations – Developing Skills of Investigation and Communication: “investigate their personal carbon footprint, using a computer simulation or numerical data (e.g., determine carbon emissions that result from their travelling to school, work, and recreation venues; from vacation travelling; from buying products imported from distant countries), and plan a course of action to reduce their footprint (e.g., a plan to increase their use of bicycles or public transit; to eat more local foods)” (p. 91)
Grade 11	Science – College	Genetic: Relating Science to Technology, Society and the Environment	Agriculture	<i>Sample Questions:</i> “In what ways can insect-resistant plants both improve agriculture and hurt biodiversity?” (p. 68)
Grade 12	Science – University	Molecular Genetics	Agriculture	Objective D3. “demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture” (p. 82)

Grade 12	Science – University	Molecular Genetics: Understanding basic concepts	Agriculture	Objective D3.5 “Describe some examples of genetic modification, and explain how it is applied in industry and agriculture (e.g., the processes involved in cloning, or in the sequencing of DNA bases; the processes involved in the manipulation of genetic material and protein synthesis; the development and mechanisms of the polymerization chain reaction)” (p. 83)
Grade 12	Science – University	Geological Processes: Relating Science to Technology, Society, and the Environment	Agriculture	<i>Sample Question:</i> “What impact do stream erosion and alluvial deposits have on agriculture along a river? What are some ways in which humans can exploit mineral resources without depleting them or harming the environment? What negative effects can construction projects have on surface water or groundwater systems? How can these effects be reduced?” (p. 145)
Grade 11	Environmental Science – U/C	Course Description	Agriculture	“This course provides students with the fundamental knowledge of and skills relating to environmental science that will help them succeed in life after secondary school. Students will explore a range of topics, including the role of science in addressing contemporary environmental challenges; the impact of the environment on human health; sustainable agriculture and forestry; the reduction and management of waste; and the conservation of energy. Students will increase their scientific and environmental literacy and examine the interrelationships between science, the environment, and society in a variety of areas.” (p. 150)
Grade 11	Environmental Science – U/C	Course Description	Agriculture	Big Ideas: “ <i>Sustainable Agriculture and Forestry</i> - Modern agricultural and forestry practices can have positive and negative consequences for the economy, human health, and the sustainability of ecosystems, both local and global.” (p. 150)
Grade 11	Environmental Science – U/C	Sustainable Agriculture and Forestry	Agriculture	Objective – Developing Skills of Investigation and Communication: “use appropriate terminology related to sustainable agriculture and forestry, including, but not limited to: bioremediation, crop rotation, companion planting, organic product,

				humus, com- post, mulch, silviculture, and naturalization” (p. 159)
Grade 11	Environmental Science – Workplace Preparation	Human Impact on the Environment	Agriculture	Objective – Understanding basic concepts: explain how human activities (e.g., agriculture, travel, the purchase of exotic pets, importing and exporting, releasing domesticated fish into fresh water environments, the use of live bait) have led to the introduction of invasive species, and why it is important to measure and monitor the impact of invasive species on native species” (p. 169)
Grade 12	Science – U/C Preparation	Science and Public Health Issues	Agriculture, Food	<i>Sample Issue</i> – “The Canadian Food Inspection Agency is responsible for administering laws that regulate agriculture and the food-processing industry. Its mandate includes monitoring farm animals for avian flu and mad cow disease and ensuring the safety of food additives. Although agency regulations have made food safer, each year many Canadians contract food- borne illnesses.” (p. 234)
Grade 12	Science – U/C Preparation	Biotechnology	Agriculture	Objective – “investigate, through laboratory inquiry or computer simulation, a recently developed biotechnological method used in the field of agriculture (e.g., bioremediation of a chemical fertilizer spill; the cloning of corn; the use of synthetic hormones to promote growth in livestock)” (p. 237)
Grade 12	Science – Workplace Preparation	Hazards in the Work place	Agriculture	Objective – Developing Skills of Investigation and Communication – “investigate the effects of workers’ exposure to heat or cold (e.g., the effects of industrial heat sources such as molten materials on workers in foundries and factories; the effects of seasonal heat and cold, including exposure to solar radiation, on outdoor workers in construction, landscaping, agriculture, or hydro line repair; the effects of cold on workers in refrigerated warehouses)” (p. 243)
Grade 11	Science – University: Biology	Scientific Investigation Skills and Career Exploration	Farm/Farmers	Objective – Career Exploration: “identify and describe a variety of careers related to the fields of science under study (e.g., zoologist, botanist, geneticist, ecologist, pharmacologist, farmer, forester, horticulturalist) and

				the education and training necessary for these careers” (p. 49)
Grade 11	Science – University: Biology	Evolution	Farm/Farmers	<i>Sample Questions:</i> “How has selective breeding of specific crops helped to increase the yield of the crop and decrease the need for chemicals in the fields? How has the introduction of genetically engineered species in the horticultural industry affected other species planted in the same areas? In what ways do the characteristics of today’s farm animals, such as cattle, pigs, and chickens, differ from those of earlier farm animals? What are the reasons for the differences?” (p. 52)
Grade 11	Science – University: Biology	Genetic Processes	Farm/Farmers	Objectives – Understanding Basic Concepts – “describe some reproductive technologies (e.g., cloning, artificial insemination, in vitro fertilization, recombinant DNA), and explain how their use can increase the genetic diversity of a species (e.g., farm animals, crops)” (p. 55)
Grade 11	Science – University: Biology	Plants: Anatomy, Growth, and Function	Farm/Farmers	<i>Sample questions:</i> How are strategies for the conservation and sustainable use of medicinal plants being used by small communities and traditional healers in some developing countries? What effect does the re-establishment of wetland plants in agricultural settings have on the natural balance of the ecosystem? How are plants being used to clean wastewater from fish farms so that the water can go back into local streams?” (p. 58)
Grade 11	Science – College – Biology	Genetics	Farm	<i>Sample issue:</i> Farmed salmon can be genetically modified to reach market size in half the time of normal sh, and cost half as much to feed. However, entire populations of wild sh could be endangered by mating with bioengineered fish that are released into the wild, with disastrous consequences for the ecosystem.” (p. 68)
Grade 12	Science – Biology – University	Molecular Genetics	Farm	<i>Sample issue:</i> Corporations that have patented genetically modified (GM) seeds legally require farmers to buy new seeds from them each planting season. Corporations that find GM crops on a farm that did not purchase their seed can take the farmer to court.

				However, natural processes such as cross-pollination can result in the migration of GM crops to neighbouring farms.” (p. 82)
Grade 12	Science – Biology – University	Population Dynamics	Farm	<i>Sample questions:</i> How are Canadian programs helping to reverse the effects of land degradation and promote sustainable farming in semi-arid and dry sub-humid areas? What is Canada’s role in the Flour Fortification Initiative, and how effectively does this initiative meet its goal of nourishing expanding populations?” (p. 86)
Grade 11	Science – Chemistry – University	Solutions and Solubility	Farm, Food	<i>“Sample questions:</i> What pollutants might be found in untreated wastewater from a chicken farm or a poultry-processing plant? How do leachates from old land II sites enter our water system? How might they affect the water quality of local streams? What are some of the sources and effects of mercury in water systems? What impact might this contaminant have on Aboriginal communities that depend on fishing as a source of food?” (p. 100)
Grade 12	Science – Chemistry – College	Organic Chemistry	Farm, Food	<i>“Sample questions:</i> Why are organic compounds often added to food products? What are the benefits, and potential health risks, to farmers of spraying pesticides on their crops? What are the health risks of eating food that has been heated in plastic containers in the microwave? What are the benefits and risks to our health of taking some common pain relief medications?” (p. 124)
Grade 12	Science – Chemistry – College	Chemical Calculations	Farm	<i>“Sample issue:</i> Farmers use fertilizers that contain nitrogen and phosphorus to fertilize their crops. Although these nutrients are needed by the crops for growth, too much fertilizer can harm crops and potentially run off into water systems and contribute to the eutrophication of ponds and lakes” (p. 128)
Grade 12	Science – Earth and Space Science - University	Geological Processes	Farm	<i>“Sample issue:</i> Volcanic eruptions can be destructive and deadly. However, because volcanic soil is rich and fertile, it is valued as farmland, and farms, towns, and even cities have developed near volcanoes. Constant monitoring of

				volcanic activity and development of evacuation plans are necessary to reduce the risk for human habitations near a volcano.” (p. 146)
Grade 11	Science – Environmental Science – U/C	Sustainable Agriculture and Forestry	Farm	<i>Sample questions:</i> “What are the economic and environmental pros and cons of growing crops that are genetically modified to be herbicide resistant? Why is organic produce more expensive than conventionally grown produce? What are the economic advantages of monoculture, both on farms and in forestry operations? How can monoculture practices lead to environmental degradation? What types of forestry practices can be implemented to maintain features of old-growth ecosystems while harvesting trees?” (p. 158)
Grade 11	Science – Environmental Science – U/C	Reducing and Managing Waste	Farm	Expectations – Relating Science to Technology, Society, and the Environment: “Evaluate the short- and long-term impact on the environment of a specific type of waste (e.g., waste products from animal farming; plastic shopping bags; tailings from mines)” (p. 160)
Grade 11	Science – Environmental Science – Workplace Preparation	Human Impact on the Environment	Farm	Expectations – Developing Skills of Investigation and Communication: “plan and conduct an inquiry, using appropriate technology, to compare soil quality in natural and disturbed environments (e.g., compare the phosphorous content, pH, organic matter content, water content, water-holding capacity, nutrient content, porosity, and/or bulk density of soil from a forest or meadow and soil from a garden or farmer’s field that has been treated with chemical fertilizer)”(p. 168)
Grade 11	Science – Environmental Science – Workplace Preparation	Human Health and the Environment	Farm	<i>Sample questions:</i> How does the use of bio solids as fertilizer on Canadian farms affect the health of local populations? What short- and long-term health problems can be traced to the chemicals in the tar ponds in Sydney, Nova Scotia?” (p. 170)
Grade 11	Science – Environmental Science –	Energy Conservation	Farm, Food	<i>Sample questions:</i> What technologies are used to produce biofuels? How do these fuels help to reduce use of non-renewable energy? What problems

	Workplace Preparation			might be associated with the use of agricultural crops for fuel rather than food? In what ways has the design of wind farm technology improved over the years? What are the advantages and disadvantages of replacing old appliances with more energy-efficient ones?" (p. 172)
Grade 11	Science – Environmental Science – Workplace Preparation	Natural Resource Science and Management	Farm	"analyse, on the basis of research, the impact that an environmental contaminant, parasite, or bacteria has on the sustainability of a natural resource in Canada (e.g., the effects of PCBs on Arctic sea mammals, of sea lice on farmed and wild salmon, of E. coli on water resources)" (p. 174)
Grade 12	Science – Physics – University	Dynamics	Farm	" <i>Sample questions:</i> How are large-scale centrifuges used in wastewater treatment? How do windmills use the principles of dynamics to generate power? What is the environmental impact of wind power and wind farms? How are linear actuators used to make the workplace more ergonomic, reducing work days lost to strain and injury?" (p. 196)
Grade 12	Science – Physics – College	Energy Transformations	Farm	" <i>Sample issue:</i> Although wind is a renewable source of energy, many windmills are needed to generate a useful amount of energy, and large wind farms can have a negative impact on wildlife and local residents. Researchers are experimenting with modifications to the blades to increase the efficiency of each windmill." (p. 218)
Grade 12	Science – Physics – College	Energy Transformations	Farm	Expectations – Understanding Basic Concepts - "compare the efficiency of various systems that produce electricity (e.g., wind farms, hydroelectric generators, solar panels), using the law of conservation of energy, and outlining the transformations, transmissions, and energy losses involved" (p. 219)
Grade 12	Science – U/C Preparation	Nutritional Science	Farm, Food	" <i>Sample Issue:</i> non-nutrient food additives increase the shelf life of many foods, decreasing waste from spoiled food and allowing foods to be transported around the globe. Importing food increases consumer choice, yet it also increases carbon

				emissions and can hurt the Canadian farm economy.” (p. 232)
Grade 12	Science – U/C Preparation	Science and Public Health Issues	Farm, Food	“ <i>Sample issue:</i> The Canadian Food Inspection Agency is responsible for administering laws that regulate agriculture and the food-processing industry. Its mandate includes monitoring farm animals for avian u and mad cow dis- ease and ensuring the safety of food additives. Although agency regulations have made food safer, each year many Canadians contract food- borne illnesses.
Grade 12	Science – U/C Preparation	Biotechnology	Farm, Food	“ <i>Sample issue:</i> The promise of genetically modified (GM) crops was that they would be resistant to pests and would produce more abundant harvests. However, GM crops can crossbreed with crops in adjoining fields, thus contaminating traditional food sources, reducing biodiversity, changing farming practices, and limiting the choices available to consumers.” (p. 236)
Grade 12	Science – Workplace Preparation	Nutritional Science	Farm, Food	Expectations – “assess the environmental implications of food choices available in a variety of situations (e.g., in the school cafeteria, a fast-food restaurant, a supermarket, a local farmers’ market, an organic meat shop), and propose ways to minimize the environmental impact of their food choices” (p. 250)
Grade 12	Science – Workplace Preparation	Nutritional Science	Farm, Food	“ <i>Sample issue:</i> Supermarkets commonly sell imported produce, distributed through large warehouses, even when the same types of food are in season locally and are available from local farmers. Importing foods generates greater carbon emissions but may be seen as more efficient if local farmers lack a reliable distribution system.” (p. 250)
Grade 12	Science – Workplace Preparation	Nutritional Science	Farm, Food	“ <i>Sample questions:</i> What is the environmental impact of organic farming compared to traditional farming methods? What are the advantages and disadvantages of buying certified organic foods from a local farmer? What are the environmental costs of purchasing a pizza?

				Why is the environmental footprint associated with consuming a hamburger different from that associated with eating a veggie burger?" (p. 250)
Grade 11	Science – Biology – University	Diversity of Living Things	Food	<i>Sample issue:</i> "Stocking lakes with fish provides recreation for fishing enthusiasts and increases the amount of food available for humans and other animals. However, this practice also increases the competition for food, which could threaten native species and affect the natural biodiversity of the aquatic ecosystem." (p. 50)
Grade 11	Science – Biology – University	Evolution	Food	<i>Sample issue:</i> "Selective breeding of agricultural crops can benefit populations in less-developed countries by producing hardier crops, increasing food supplies, and improving the nutritional content of food. However, opponents of artificial selection technology believe that it affects the natural ability of a species to reproduce, which negatively affects biodiversity." (p. 52)
Grade 11	Science – Biology – University	Animals: Structure and Function	Food	Expectations – "assess how societal needs (e.g., the need for healthy foods; the need to counteract the effects of sedentary lifestyles) lead to scientific and technological developments related to internal systems (e.g., advances in dietary products and fitness equipment; improved standards for transplanting organs)" (p. 56)
Grade 11	Science – Biology – University	Plants: Anatomy, Growth, and Function	Food, Agricultural	<i>Sample issue:</i> "The agricultural sector holds great economic potential as demand increases for products such as biofuels, biochemical, and biopharmaceuticals. Bio resources could also support our efforts to produce renewable energy, improve health, and minimize environmental impact. However, critics are concerned about the impact of bio resources on the availability of food crops and the price of food." (p. 58)
Grade 11	Science – Biology – College	Scientific Investigation Skills and Career Exploration	Food	Expectations – Career Exploration – "identify and describe a variety of careers related to the fields of science under study (e.g., food science technologist, medical laboratory technologist, dental hygienist, outpost

				clinic/primary care nurse, respiratory therapist, veterinary technician, water or wastewater technician) and the education and training necessary for these careers” (p. 63)
Grade 11	Science – Biology – College	Microbiology	Food	<i>Sample issue:</i> “Genetically modified microorganisms are used in many biotechnological applications that benefit humans, in areas such as food production, the development of antibiotics and vaccines, and waste disposal. However, some of the same techniques could be used to manipulate microorganisms to create rapidly reproducing drug-resistant superbugs for use as bioweapons.” (p. 66)
Grade 11	Science – Biology – College	Microbiology	Food	<i>Sample questions:</i> “Should suppliers be required to label foods that have been modified using microorganisms, so that consumers can make more informed decisions about the food they eat? Why or why not? What do we know about the side effects and possible long-term effects of the medical and cosmetic uses of botulinum toxin? Do you think the use of this substance is adequately regulated?” (p. 66)
Grade 11	Science – Biology – College	Genetics	Food	<i>Sample questions:</i> “What are the risks of growing genetically modified crops near fields where traditional crops are growing? Why have some countries banned genetically modified food crops? What impact has the introduction of herbicide-tolerant plants had on local environments? In what ways can insect-resistant plants both improve agriculture and hurt biodiversity? What are some of the possible effects on the environment of releasing bioengineered insects into the wild?” (p. 68)
Grade 11	Science – Biology – College	Anatomy of Mammals	Food	<i>Sample issue:</i> “The importance of a sensible diet and regular exercise in maintaining healthy body weight is well known. Yet the popularity of fast food and computer games means that many young people are eating too much fat and are not getting enough physical activity. Consequently, childhood obesity levels are on the rise in Canada.” (p. 70)

Grade 11	Science – Biology – College	Plants and the Natural Environment	Food	<i>Sample issue:</i> “the greening of cities with a variety of native plant species helps to maintain biodiversity, restore natural landscapes, and provide food and habitat for local wildlife. However, many urban gardeners introduce non-native plants, which can compete with the native species and may not be hospitable to the local wildlife” (p. 72)
Grade 12	Science – Biology – University	Biochemistry	Food	Expectations: “analyse technological applications related to enzyme activity in the food and pharmaceutical industries (e.g., the production of dairy products; bread making; the use of enzymes to control reaction rates in pharmaceuticals)” (p. 78)
Grade 12	Science – Biology – University	Biochemistry	Food	<i>Sample questions:</i> “Why are there so many different varieties of cheese when the production process is basically the same for all cheeses? What types of food production processes use enzymes to improve production yields? How do they do so? How and why are enzymes used as pharmaceutical supplements to treat digestive system disorders such as celiac disease and lactose intolerance?” (p. 78)
Grade 12	Science – Biology – University	Molecular Genetics	Food	<i>Sample issue:</i> “Modern biotechnologies, such as selective breeding, are regulated under Health Canada’s Food and Drugs Act and the Canadian Environmental Protection Act. It is an ongoing challenge to ensure that our regulations keep up with advances in scientific knowledge and technologies, as well as with developments in other countries.” (p. 82)
Grade 12	Science – Chemistry – University	Organic Chemistry	Food	Expectations – “assess the impact on human health, society, and the environment of organic compounds used in everyday life (e.g., polymers, nutritional supplements, food additives, pharmaceuticals, pesticides)” (p. 108)
Grade 12	Science – Chemistry – College	Organic Chemistry	Food	<i>Sample questions:</i> “Why are organic compounds often added to food products? What are the benefits, and potential health risks, to farmers of spraying pesticides on their crops? What are the health risks of eating food

				that has been heated in plastic containers in the microwave? What are the benefits and risks to our health of taking some common pain relief medications?" (p. 124)
Grade 11	Science – Environmental Science – U/C	Scientific Solutions to Contemporary Environmental Challenges	Food	<i>Sample issue:</i> "Greenhouse gas emissions from motor vehicles are a major contributor to global warming. The use of ethanol and other biofuels in motor vehicles reduces these emissions. However, diverting crops from food production to fuel production can increase prices and decrease the supply of food." (p. 154)
Grade 11	Science – Environmental Science – U/C	Scientific Solutions to Contemporary Environmental Challenges	Food	<i>Sample questions:</i> "What are some of the social and economic challenges associated with cleaning up and conserving fresh water supplies? What are some alternative energy sources? What social and economic challenges are associated with their development? In what ways can consuming locally grown foods help the local economy, society, and the environment?" (p. 154)
Grade 11	Science – Environmental Science – U/C	Sustainable Agriculture and Forestry	Food	<i>Sample question:</i> "What was the source of contamination of well water in Walkerton, Ontario, in 2000? What are the immediate and long-term health effects of exposure to E. coli? What is known about the long-term effects of consuming genetically modified food? What impact could the spraying of forest canopies to prevent gypsy moth infestations have on human health?" (p. 158)
Grade 11	Science – Environmental Science – Workplace Preparation	Energy Conservation	Food	<i>Sample questions:</i> "What technologies are used to produce biofuels? How do these fuels help to reduce use of non-renewable energy? What problems might be associated with the use of agricultural crops for fuel rather than food? In what ways has the design of wind farm technology improved over the years? What are the advantages and disadvantages of replacing old appliances with more energy-efficient ones?" (p. 172)
Grade 12	Science – U/C Preparation	Pathogens and Disease	Food	<i>Sample questions:</i> "How does the irradiation of food reduce the incidence of food-borne illness? Why is the use of this technology controversial? What are the pros and cons of using

				insecticides such as DDT to kill malaria-carrying mosquitoes? What are the advantages and disadvantages of using “no touch” technologies to stem the spread of diseases?” (p. 230)
Grade 12	Science – U/C Preparation	Pathogens and Disease	Food	Expectations – “describe the mode of transmission of various diseases, including those that are insect-borne (e.g., malaria, encephalitis), airborne (e.g., influenza, tuberculosis), water-borne (e.g., cholera, poliomyelitis), sexually transmitted (e.g., HIV/AIDS), and food-borne (e.g., mad cow disease, trichinosis, salmonella)” (p. 231)
Grade 12	Science – U/C Preparation	Nutritional Science	Food	<i>Sample questions:</i> “What effect does advertising have on your food choices? How do food allergies affect the diets of individuals and the food choices available in school cafeterias? Why do people with diabetes have to monitor their consumption of sugar and carbohydrates? What impact does anorexia have on a person’s eating behaviours? What effect can a person’s cultural background have on their food choices?” (p. 232)
Grade 12	Science – U/C Preparation	Nutritional Science	Food	<i>Sample issue:</i> “Non-nutrient food additives cultural background have on their food choices? increase the shelf life of many foods, decreasing waste from spoiled food and allowing foods to be transported around the globe. Importing food increases consumer choice, yet it also increases carbon emissions and can hurt the Canadian farm economy.” (p. 232)
Grade 12	Science – U/C Preparation	Science and Public Health Issues	Food	<i>Sample issue:</i> “The Canadian Food Inspection Agency is responsible for administering laws that regulate agriculture and the food-processing industry. Its mandate includes monitoring farm animals for avian u and mad cow dis- ease and ensuring the safety of food additives. Although agency regulations have made food safer, each year many Canadians contract food- borne illnesses.” (p. 234)
Grade 12	Science – U/C Preparation	Biotechnology	Food	<i>Sample issue:</i> “The promise of genetically modified (GM) crops was that they would be resistant to pests and would produce more abundant harvests. However, GM crops can

				crossbred with crops in adjoining fields, thus contaminating traditional food sources, reducing biodiversity, changing farming practices, and limiting the choices available to consumers.” (p. 236)
Grade 12	Science – U/C Preparation	Biotechnology	Food	<i>Sample questions:</i> “If a disease has no known cure, should we use biotechnology to predict or diagnose its occurrence in individuals? Why or why not? Who owns or controls frozen embryos left over after in vitro fertilization? Who determines whether genetically modified foods are safe? How might the testing/regulation process be open to abuse? What are the legal and ethical implications of introducing into an ecosystem a species engineered through biotechnology?” (p. 236)
Grade 12	Science – U/C Preparation	Biotechnology	Food	Expectations – Developing Skills of Investigation and Communication – “plan and conduct an inquiry into various traditional biotechnological techniques used in the food industry (e.g., the use of fermentation to produce bread, cheese, yogurt)” (p. 236)
Grade 12	Science – Workplace Preparation	Diseases and its Prevention	Food	<i>Sample issue:</i> “The federal government established the Canadian Food Inspection Agency to ensure that the food eaten by Canadians is safe. Despite its regulations, food-borne illnesses such as salmonella, listeriotic, and mad cow disease continue to occur.” (p. 246)
Grade 12	Science – Workplace Preparation	Nutritional Science	Food	Expectations – “assess the environmental implications of food choices available in a variety of situations (e.g., in the school cafeteria, a fast-food restaurant, a supermarket, a local farmers’ market, an organic meat shop), and propose ways to minimize the environmental impact of their food choices” (p. 250)
Grade 12	Science – Workplace Preparation	Nutritional Science	Food	<i>Sample issue:</i> “Supermarkets commonly sell imported produce, distributed through large warehouses, even when the same types of food are in season locally and are available from local farmers. Importing foods generates greater carbon emissions but

				may be seen as more efficient if local farmers lack a reliable distribution system.” (p. 250)
Grade 12	Science – Workplace Preparation	Nutritional Science	Food	<i>Sample question:</i> “What is the environmental impact of organic farming compared to traditional farming methods? What are the advantages and disadvantages of buying certified organic foods from a local farmer? What are the environmental costs of purchasing a pizza? Why is the environmental footprint associated with consuming a hamburger different from that associated with eating a veggie burger?” (p. 250)
Grade 11	Science – Biology – University	Diversity of Living Things	Agricultural	Expectations – “analyse some of the risks and benefits of human intervention (e.g., tree plantations; monoculture of livestock or agricultural crops; overharvesting of wild plants for medicinal purposes; using pesticides to control pests; suppression of wild fires) to the biodiversity of aquatic or terrestrial ecosystems” (p. 50)
Grade 11	Science – Biology – University	Diversity of Living Things	Agricultural, Food	<i>Sample questions:</i> “why do higher temperatures affect the survival of some species in freshwater environments? Why would an increase in ocean temperatures endanger many species that depend on coral as a home and food supply? In what ways have longer growing seasons, which may include a second harvest, affected the biodiversity of agricultural lands? How might species such as the Eastern Massasauga rattlesnake be affected by increased water levels in their habitats?” (p. 50)
Grade 11	Science – Biology – University	Evolution	Agricultural, Food	<i>Sample issue:</i> “Selective breeding of agricultural crops can benefit populations in less-developed countries by producing hardier crops, increasing food supplies, and improving the nutritional content of food. However, opponents of artificial selection technology believe that it affects the natural ability of a species to reproduce, which negatively affects biodiversity.” (p. 52)
Grade 11	Science – Biology – University	Plants: Anatomy, Growth and Function	Agricultural, Food	<i>Sample questions:</i> “In what ways does the local food movement contribute to

				community development? How does the re-introduction of native plant species along river banks help to prevent land erosion? What plant species are considered important in sustaining Canada's growth in the agricultural sector? How might the increasing demand for straw-bale housing materials support Canada's agricultural sector and increase the sustainability of other natural resources?" (p. 58)
Grade 11	Science – Biology – University	Plants: Anatomy, Growth and Function	Agricultural	Expectations – “evaluate on the basis of research, ways in which different societies or cultures have used plants to sustain human populations while supporting environmental sustainability (e.g. sustainable agricultural practices in developing countries such as crop rotation and seed saving; traditional Aboriginal corn production practices)” (p. 58)
Grade 12	Science – Biology – University	Homeostasis	Agricultural	<i>Sample issue:</i> “Human-produced biosolids are a low-cost source of nutrient-rich organic matter that is often spread on agricultural land rather than being sent for incineration or land fill disposal. Opponents of land application of biosolids are concerned about the potential health impact of heavy metals, bacteria, and drugs that may remain in the biosolids.” (p. 84)
Grade 11	Science – Chemistry – University	Solutions and Solubility	Agricultural	Expectations – “analyze the origins and cumulative effects of pollutants that enter our water systems (e.g., land fill leachates, agricultural run-off, industrial effluents, chemical spills), and explain how these pollutants affect water quality” (p. 100)
Grade 11	Environmental Science – U/C	Sustainable Agriculture and Forestry	Agricultural	Expectations – “ evaluate, on the basis of research, a variety of agricultural and forestry practices (e.g., companion planting, biological pest control, the use of genetically modified seed, forest re control) with respect to their impact on the economy and the environment (e.g., the use of nematodes eliminates crop damage from grubs, thus contributing to better harvests, while reducing the use of toxic chemical pesticides; under some circumstances, forest thinning can help prevent or

				reduce the seriousness of forest re, and its economic and environmental consequences)” (p. 158)
Grade 11	Environmental Science – U/C	Sustainable Agriculture and Forestry	Agricultural	Expectations – “evaluate, on the basis of research, the impact, including the long-term impact, of agricultural and forestry practices on human health (e.g., the use of chemical fertilizers and pesticides; the use of growth hormones and antibiotics in livestock; the use of feed containing animal by-products; the clear-cutting of forests)” (p. 158)
Grade 11	Environmental Science – U/C	Sustainable Agriculture and Forestry	Agricultural	Expectations – “use a research process to investigate environ- mentally sustainable methods of managing and maintaining healthy and productive agricultural zones and forests (e.g., companion planting, crop rotation, selective tree-harvesting, planting a diverse canopy)” (p. 159)
Grade 11	Environmental Science – U/C	Sustainable Agriculture and Forestry	Agricultural	Expectations – “explain agricultural techniques and forestry practices that aim to maintain both biodiversity and long-term productivity (e.g., growing a variety of species, inter-planting crops, planting native and heritage varieties instead of hybrids or transgenic species, saving seeds, maintaining some older trees and snags for animal habitat)” (p. 159)
Grade 11	Environmental Science – U/C	Sustainable Agriculture and Forestry	Agricultural	Expectations – “describe sustainable water-management practices in agricultural and forestry settings (e.g., regulating the frequency of watering, planting species suited to local precipitation levels, limiting run-off and erosion)” (p. 159)
Grade 11	Environmental Science – U/C	Human Impact on the Environment	Agricultural	<i>Sample questions:</i> “How can various kinds of chemical spills in local ecosystems (e.g., fields, rivers, streams) be cleaned up? In what ways does improper sewage treatment or agricultural run-off threaten local water supplies, and how can these dangers be addressed or averted? What can be done to minimize the effect of an invasive species (e.g., purple loosestrife) on a native species (e.g., milkweed)?” (p. 168)
Grade 11	Environmental Science – U/C	Energy Conservation	Agricultural, Food	<i>Sample questions:</i> “hat technologies are used to produce biofuels? How do these fuels help to reduce use of non-

				renewable energy? What problems might be associated with the use of agricultural crops for fuel rather than food? In what ways has the design of wind farm technology improved over the years? What are the advantages and disadvantages of replacing old appliances with more energy-efficient ones?"
Grade 11	Science – Physics – University	Electricity and Magnetism	Agricultural	<i>Sample questions:</i> "How efficient are the small- and large-scale solar-power systems used in individual homes and industrial settings? What is the environmental impact of the generation of solar power? What technologies are being used to improve the efficiency of energy sources such as coal and biofuel? What impact does the increasing use of biofuels have on air quality, land use, and agricultural practices?" (p. 192)
Grade 12	Science – Physics – University	Gravitational, Electric, and Magnetic Fields	Agricultural	<i>Sample questions:</i> "What are some of the uses of particle accelerators, and how have these benefited society? What is the effect on human health of long-term exposure to the electrical fields created by high-voltage lines? How could zero-gravity experiments on agricultural products benefit society and the environment? What are the environmental benefits of using technology involving gravitational fields to search for mineral deposits?" (p. 202)
Grade 12	Science – U/C Preparation	Biotechnology	Agricultural	Expectations – "analyse social issues related to an application of biotechnology in the health, agricultural, or environmental sector (e.g., issues related to the uses of genetically modified organisms or to the uses and availability of in vitro fertilization)" (p. 236)
Grade 12	Science – U/C Preparation	Biotechnology	Agricultural	Expectations – "analyse, on the basis of research, ethical and legal issues related to an application of biotechnology in the health, agricultural, or environmental sector (e.g., ethical questions related to xenotransplantation; legal issues related to access to an individual's genetic information)" (p. 236)

Grade 12	Science – U/C Preparation	Biotechnology	Agricultural	Expectations – “describe applications of biotechnology in the health (e.g., genomics, gene therapy, xenotransplantation, in vitro fertilization), agricultural (e.g., genetically modified crops, bio pesticides, cloning), and environmental sectors (e.g., bioremediation, phytoremediation)” (p. 237)
Grade 10	Environmental Education Resource	Canadian History Since World War – Academic	Agriculture	“describe some key economic trends and developments in Canada during this period (e.g., ... <i>the impact of the dustbowl on agriculture, ...</i>), and assess their impact on different groups in Canada” (p. 38)
Grade 12	Environmental Education Resource	Adventures in World History – Workplace Preparation	Agriculture	“explain some ways in which environmental factors affected people in selected societies during this period (e.g., the importance of bodies of water in settlement and transportation; natural defences such as deserts or mountains; the impact on agriculture of annual flooding in the Fertile Crescent; deforestation in Sumer; the role of natural resources in economic development; famine caused by drought or pests; disease spread by insects; the use of local materials in artistic/artisanal production)” (p. 56-57)
Grade 11	Environmental Education Resource	Extended French – University	Agriculture	<i>Writing – Creating Media Texts</i> : “create media texts in French on a variety of topics, using forms, conventions, and techniques appropriate to the purpose and audience (e.g., ... <i>write a letter to the editor of a periodical stating the pros and cons of using genetically modified organisms in agriculture or in medicine</i>)” (p. 98)
Grade 12	Environmental Education Resource	World Cultures – U/C Preparation	Agriculture, Food	Cultural Expressions – “assess the broad significance of historic cultural developments associated with a diverse range of ethnocultural groups (e.g., ...the Three Sisters of Haudenosaunee agriculture; tobacco; ... foods/beverages such as pasta, rice, ketchup, corn, potatoes, tea, coffee, wine)” (p. 201)

Grade 12	Environmental Education Resource	Nutrition and Health – University	Agriculture, Food	Food Production and Supply – “analyse the effect of various trends in agriculture and aquaculture (<i>e.g., organic farming, ...</i>) on local and global food supply and production” (p. 210)
Grade 12	Environmental Education Resource	Challenge and Change in Society – University	Agriculture	Technological Change – “explain how technological advances (<i>e.g. in... agriculture, recycling</i>) lead to cultural adaptations” (p. 219)
Grade 12	Environmental Education Resource	Green Industries – U/C Preparation	Agriculture, Farm, Food	Technology and Society – “assess the economic importance of linkages between the green industries and related industries and technologies (<i>e.g., agriculture: food processing industry, farm implement industry; horticulture: shipping industry, event-related businesses [funeral homes, wedding planners]; landscaping: recreational industries, small-engine industry; forestry: heavy equipment industry, paper-consuming industries such as newspapers</i>)” (p. 249)
Grade 12	Environmental Education Resource	Green Industries – U/C Preparation	Agriculture	Business and Regulatory Environment – “identify industry associations, government departments, and non-governmental organizations that are involved with matters that affect the green industries (<i>e.g., local growers’ associations; provincial and federal agriculture, health, environment, and resource departments; environmental NGOs</i>)” (p. 250)
Grade 11	Environmental Education Resource	Dance - Open	Agricultural	“identify and describe different types of dance represented in a particular culture, and describe their purposes (<i>e.g., the characteristics of rain dances in ancient Egypt and their relationship to environmental factors, agricultural practices, and religious beliefs</i>)” (p. 15)
Grade 11	Environmental Education Resource	American History – University	Agricultural	“identify some of the main challenges and opportunities presented by the environment in the United States during this period, with reference to both Native American nations and European colonists (<i>e.g., variations in climate, land forms, natural resources</i>), and analyse their impact (<i>e.g., whether communities were nomadic or settled, agricultural or hunter-based; items/materials available for trade, production, and/or consumption;</i>

				<i>impact on housing, clothing, crops, and/or transportation routes)” (p. 52)</i>
Grade 11	Environmental Education Resource	Origins of Citizenship: The History of a Canadian Ethnic Group – Open	Agricultural	“Sample questions: “In what ways did changes in land use or agricultural practices over time affect some people’s decisions to emigrate?” “What impact might a government’s decision to alter the land use of a specific region have had on the decision of some people to emigrate?” (p. 55)
Level 2	Environmental Education Resource	Classical Languages (Ancient Greek/Latin) – University	Agricultural	“demonstrate knowledge and understanding of diverse aspects of life in the classical world, using several different strategies (e.g., ... outline mining techniques and/or agricultural practices used in the ancient Mediterranean world and describe their environmental impact” (p. 69)
Level 2	Environmental Education Resource	English as a Second Language – Open	Agricultural	“demonstrate knowledge of a variety of facts about Canada (e.g., describe similarities and differences among the regions of Canada with respect to their major economic activities, immigration patterns, weather, geographical features, and industrial and agricultural production; ...)” (p. 86)
Grade 12	Environmental Education Resource	Nutrition and Health – University	Agricultural, Food	“Teacher prompts: “In what ways have food supply and production and water potability been affected after a recent natural disaster?” “Which countries’ or regions’ food supplies are most at risk because of climate change?” “How does climate change affect the food supply of indigenous people, in particular?” “How might climate change affect the different agricultural regions of Canada?”” (p. 212)
Grade 12	Environmental Education Resource	Nutrition and Health – University	Agricultural, Food	“demonstrate an understanding of health, safety, and environmental issues related to food supply and production (e.g., risks associated with the bioaccumulation of pesticides and hormones, risks of contamination during food production), and describe key aspects of legislation that is designed to protect Canadian consumers (e.g., Canadian Agricultural Products Act, Food and Drugs Act)” (p. 213)

Grade 12	Environmental Education Resource	Nutrition and Health – College	Agricultural, Food	“explain the effect on the environment of various agricultural trends (e.g., growing crops for biofuels) and food-production technologies (e.g., types of farm equipment, types of energy sources, climate-control techniques, genetic engineering of foods)” (p. 214)
Grade 9	Environmental Education Resource	Exploring Technologies – Open	Agricultural	“describe how various technologies (e.g., integrated pest management, water purification, mass transit, agricultural technologies, resource extraction) affect the environment, and identify important environmental considerations associated with different areas of technology (e.g., how to deal with ozone-depleting chemicals or hazardous wastes; how to increase opportunities for recycling, conservation, use of sustainable methods or materials)” (p. 227)
Grade 11	Environmental Education Resource	Green Industries – U/C Preparation	Agricultural	“identify geographical regions on the basis of classification criteria relevant to the green industries (e.g., forest type, hardiness, agricultural use, ease of cultivation, water features)” (p. 244)
Grade 11	Environmental Education Resource	Green Industries – U/C Preparation	Agricultural, Food	“analyse societal issues relating to the green industries, and identify ways of resolving them, taking a variety of perspectives into account (e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products, fuel ethanol versus food production)” (p. 246)
Grade 11	Environmental Education Resource	Green Industries – Workplace Preparation	Agricultural	“describe societal issues relating to the green industries and identify ways of resolving them (e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products)” (p. 249)

Grade 11	Environmental Education Resource	Technological Design – U/C Preparation	Agricultural	“research and compare technological eras (e.g., agricultural, industrial, information), and describe ways in which societal needs influenced these eras” (p. 265)
Grade 10	Environmental Education Resource	Canadian History Since World War 1 – Applied	Farm	“identify some major developments in science and/or technology during this period, and explain how they changed the lives of people in Canada (e.g., ... the advent of commercial fertilizers and pesticides helped farmers but also had consequences for the environment)” (p. 41)
Grade 12	Environmental Education Resource	Analysing Current Economic Issues – University	Farm, Food	“analyse how different stakeholders view the trade-off between economic growth and concerns for the environment (e.g., with reference to coal- red electrical plants to support manufacturing in China and concerns about air quality; debates about the economic and environmental impact of the North American energy pipelines and/or the continuing development of the Alberta oil sands; the expansion of farmland at the expense of rain forest; innovations such as genetically modified seeds/foods and their impact on ecosystems; firms that invest in the development of non-renewable resources and those that fund research on alternative energy)” (p. 46)
Grade 11	Environmental Education Resource	American History – University	Farm	<i>Sample question:</i> “What impact did the suitability of land for crops such as tobacco have on dominant groups in American society during this period? What were some of the long-term effects of tobacco farming?” (p. 50)
Grade 11	Environmental Education Resource	World History to the End of the Fifteenth Century, U/C Preparation	Farm	<i>Sample question:</i> “What role did farming practices play in the decline of the Mesopotamian Empire?” (p. 51)
Level 3	Environmental Education Resource	International Languages – Open	Farm	“producing Oral Communications: produce rehearsed, some detailed, and spontaneous messages in the target language to communicate information and ideas about a variety of topics, with contextual, auditory, and visual support as appropriate (e.g., ... present a summary of a current or proposed environmental project, such as mining, forestry, wind turbine farms, or clean

				water access, in a country where the target language is spoken)” (p. 76)
Grade 12	Environmental Education Resource	Introductory Kinesiology	Farm	“Teacher prompt: “The built environment is that part of our surroundings that has been constructed by humans. It is where most of our activities take place. A city is a built environment. So is a cabin in the woods or a farm. A growing body of evidence suggests there is a relationship between the built environment and physical activity, rates of obesity, and heart disease and stroke. How can the characteristics of a built environment affect physical activity rates and the health of a community? What can be done to make a community’s-built environment healthier?” (p. 123)
Grade 11	Environmental Education Resource	Gender Studies – U/C Preparation	Farm	“analyse the relationship between gender and environmental issues in both Canadian and global contexts (e.g., ... the impact of desertification on arable land, family farms, and the roles of women and men; differences in the impact of climate change on men and women)” (p. 198)
Grade 12	Environmental Education Resource	Equity and Social Justice: From Theory to Practice – U/C Preparation	Farm	“Teacher prompts: ... “What effect has the marketing of fair-trade products had on farm economies in developing countries?” (p. 200)
Grade 12	Environmental Education Resource	World Cultures – U/C Preparation	Farm	“Teacher prompts: ... “What was the role of East Africa and the Arab world in the popularization of coffee? How important is the coffee trade to today’s global economy? What have been the effects of the trade on local farmers who cultivate this crop?” (p. 201)
Grade 10	Environmental Education Resource	Clothing – Open	Farm	“ explain how knowledge of natural and synthetic fibres and fabrics, including how they are produced, can affect clothing choices (e.g., the selection of ... organic cotton or hemp to limit environmental damage arising from the production of traditionally farmed cotton or petroleum-based polyester ...)” (p. 203)
Grade 11	Environmental Education Resource	Understanding Fashion – College	Farm	“describe the environmental impact of the production, use, and care of various fibres and fabrics (e.g., the impact of farming cotton, hemp, bamboo, sheep, silkworms; of the production process

				for various synthetic fabrics and dyes; of dry cleaning)” (p. 204)
Grade 9 or 10	Environmental Education Resource	Food and Nutrition – Open	Farm, Food	“assess programs and practices that reduce the impact of food production and consumption on the environment (e.g., recycling programs, organic farming, food co-ops, community gardens)” (p. 207)
Grade 11	Environmental Education Resource	Food and Culture – U/C	Farm, Food	“Compare some food-production and food-acquisition practices in Canada to those in a variety of other countries/cultures (e.g., with reference to: cultivation on small family farms versus large monoculture farms; the role of hunting and fishing; organic farming practices versus the use of chemicals and genetically modified seeds/plants; buying packaged goods and butchered meat in grocery stores versus fresh produce and live animals in markets ...)”(p. 208)
Grade 11	Environmental Education Resource	Food and Culture – Workplace Preparation	Farm, Food	“describe some food-production and food-acquisition practices in Canada and in a variety of other countries/cultures (e.g., cultivation on small family farms, organic farming practices, large monoculture farms, the use of chemicals and genetically modified seeds/plants, the role of hunting and fishing ...)” (p. 209)
Grade 12	Environmental Education Resource	Nutrition and Health – University	Farm, Food	“analyse the effect of various trends in agriculture and aquaculture (e.g., organic farming, ...) on local and global food supply and production” (p. 210)
Grade 12	Environmental Education Resource	Nutrition and Health – College	Farm, Food	“describe how consumer food choices affect the environment, locally and globally (e.g. demand for imported food increases the amount of energy used in transportation; choice of over packaged products increases the volume of waste going to landfills; choice of fair-trade products supports sustainable farming and small-scale farmers; demand for local produce supports farmers’ markets and reduces use of fossil fuels)” (p. 212)
Grade 10	Environmental Education Resource	Green Industries – Open	Farm, Food	“describe the relationships between a variety of local green industries and their local outlets (e.g., garden centre and nursery, vegetable production and farmers’ market, maple syrup

				production and specialty food store, flower producer and florist)” (p. 227)
Grade 11	Environmental Education Resource	Green Industries – U/C Preparation	Farm	“demonstrate an understanding of and apply the steps in a design process ... to a variety of requirements in the green industries (e.g., creation of forest management plans, environmental farm plans, urban landscape designs, hydroponic system designs)” (p. 243)
Grade 11	Environmental Education Resource	Green Industries – U/C Preparation	Farm	“identify sustainable practices and guidelines that are currently applied within the green industries or may be applied in the future (e.g., environmental farm planning, integrated pest management, xeriscaping, forest regeneration, low-till cultivation)” (p. 244)
Grade 11	Environmental Education Resource	Green Industries – U/C Preparation	Farm	“describe careers in the green industries (e.g., landscape architect, forest manager, horticulturalist, farm manager, turf manager, botanist, veterinarian) and the education, training, and certification required for entry into these occupations” (p. 242)
Grade 11	Environmental Education Resource	Green Industries – Workplace Preparation	Farm	“identify sustainable practices and guidelines that are currently applied within the green industries or may be applied in the future (e.g., environmental farm planning, sustainable forest management, integrated pest management, sustainable golf course maintenance, select spraying, energy-efficient greenhouse production)” (p. 245)
Grade 12	Environmental Education Resource	Green Industries – U/C Preparation	Farm	“assess the effects of interactions between abiotic, biotic, and cultural factors on a variety of ecosystems (e.g., forests in various stages of natural succession, golf courses, fish farms, organic farms, riparian zones)” (p. 247)
Grade 12	Environmental Education Resource	Green Industries – U/C Preparation	Farm	“investigate areas of specialization within the green industries (e.g., lighting systems, water features, irrigation systems, GIS analysis, robotics, automation, entomology, pathology, tissue culture, agronomy, marketing, environmental management, farm management)” (p. 247)
Grade 12	Environmental Education Resource	Workplace Preparation	Farm	“assess the environmental sustainability of various practices and procedures used in the green industries

				(e.g., harvesting methods, wood product manufacturing methods, naturalized landscaping, global floral sourcing, environmental farm plans, crop rotation, large-scale farming)”
Grade 10	Environmental Education Resource	Canadian History Since World War 1 – Academic	Food	“identify some major developments in science and technology since 1982 (e.g., ... electric and hybrid cars, fossil fuel extraction technologies, ... genetically modified foods, developments in alternative energy), and assess their significance for people in Canada” (p. 39)
Grade 11	Environmental Education Resource	The Individual and the Economy – U/C Preparation	Food	“explain how needs (e.g., clean water, food, ...), wants (e.g., ... fair-trade produce), and values (e.g., fairness, individualism, community mindedness) influence consumer decisions” (p. 43)
Grade 12	Environmental Education Resource	Analyzing Current Economic Issues – University	Food	“analyse how different stakeholders view the trade-off between economic growth and concerns for the environment (e.g., with reference to coal- red electrical plants to support manufacturing in China and concerns about air quality; debates about the economic and environmental impact of the North American energy pipelines and/or the continuing development of the Alberta oil sands; the expansion of farmland at the expense of rain forest; innovations such as genetically modified seeds/foods and their impact on ecosystems; firms that invest in the development of non-renewable resources and those that fund research on alternative energy)” (p. 46)
Grade 12	Environmental Education Resource	Canadian and International Politics – University	Food	“explain key challenges relating to some specific issues of national and global political importance (e.g., ... climate change, protection of endangered species, loss of rainforest, food and water scarcity ...)” (p. 64)
Grade 9	Environmental Education Resource	Healthy Active Living Education – Open	Food	“Students: ... “I am concerned about the impact of food choices on the environment, so I will also consider how and where the food is produced and how it is packaged.” ...” (p. 116)
Grade 9	Environmental Education Resource	Healthy Active Living Education – Open	Food	“analyse the influence of social and environmental factors on food and beverage choices (e.g., ... environmental impact of food production methods)

				<p>Teacher prompt: “What are some social and environmental factors that affect a person’s food choices?”</p> <p>Students: ... “Things like food production, transportation, and packaging can have a serious impact on the environment. To reduce my carbon footprint and other environmental impacts, I try to choose local fresh food.” ... “Food choices may not be the same in every part of Ontario because of differences in the kinds of foods that can be produced in or easily shipped to different areas, like the Far North, rural areas or cities.” (p. 116)</p>
Grade 10	Environmental Education Resource	Healthy Active Living Education – Open	Food	<p>“demonstrate an understanding of how they, as consumers, can have an impact on food and beverage choices at school and in the community (e.g., ... raising awareness of ethical and environmental considerations related to food choices)” (p. 117)</p>
Grade 11	Environmental Education Resource	Healthy Active Living Education – Open	Food	<p>“identify current issues that involve food either directly or indirectly (e.g., issues involving food safety or quality, such as pesticide use, genetic modification of crops, the sale of non-pasteurized milk products; issues involving food marketing and advertising; environmental issues, such as climate change, packaging and waste reduction, water pollution, biodiversity, long-range transportation of food; ...), and explain how healthy eating choices are related to these issues.” (p. 118)</p>
Grade 11	Environmental Education Resource	Healthy Active Living Education – Open	Food	<p>“Issues related to food are often in the news. Let’s think about two of them. One involves the influence of the media and advertising on our values and behaviour; the other concerns the genetic modification of food crops. How might these issues be related to food choices? Do people’s choices have an effect on these issues? How might these issues affect someone’s choices?” (p. 120)</p>
Grade 11	Environmental Education Resource	Healthy Active Living Education – Open	Food	<p>““Some foods in Canada now come from genetically modified crops. Some people worry that genetic modification could be harmful to biodiversity or human health, while others believe that it is essential to maintain the</p>

				current food supply. Current regulations do not require genetically modified ingredients in food to be identified on the product label. Some people feel this information should be included so that people can make an informed decision about whether to buy that product.” (p. 120)
Grade 11	Environmental Education Resource	Health for Life – College	Food	“explain the role of government policies and programs in protecting school and community health (e.g., ... The Smoke-Free Ontario Act; Safe Drinking Water Act, 2002; The Local Food Act, 2013; Highway Traffic Act sections relating to bike safety...) ...” (p. 123)
Grade 9 or 10	Environmental Education Resource	Exploring Family Studies – Open	Food	“describe strategies for making informed and responsible consumer decisions Teacher prompts: ... “Why is it important to consider where our food is grown and where products are made? How can buying locally grown foods decrease our environmental footprint?” (p. 203)
Grade 9 or 10	Environmental Education Resource	Food and Nutrition – Open	Food	“identify different factors that influence people’s food choices (e.g., ... environmental ...) Teacher prompts: “Why do some people choose to be vegetarian?” “How can you modify your food choices to reduce your impact on the environment?” “Why might some people choose to eat organic foods while others choose to eat local foods as a way of reducing their impact on the environment?” ...” (p. 207)
Grade 9 or 10	Environmental Education Resource	Food and Nutrition – Open	Food	“explain how various factors affect the availability of local foods (e.g., proximity to agricultural land, length of growing season, ... weather, soil conditions) Teacher prompts: ... “What makes the Niagara region so well suited to growing peaches and other soft fruits?”” (p. 207)
Grade 9 or 10	Environmental Education Resource	Food and Nutrition – Open	Food	“assess programs and practices that reduce the impact of food production and consumption on the environment (e.g., recycling programs, organic farming, food co-ops, community gardens)” (p. 207)

Grade 11	Environmental Education Resource	Food and Culture – U/C	Food	<p>“compare some food-production and food-acquisition practices in Canada to those in a variety of other countries/cultures (e.g., with reference to: cultivation on small family farms versus large monoculture farms; the role of hunting and fishing; organic farming practices versus the use of chemicals and genetically modified seeds/plants; buying packaged goods and butchered meat in grocery stores versus fresh produce and live animals in markets ...)” (p. 208)</p>
Grade 12	Environmental Education Resource	Nutrition and Health – University	Food	<p>“Teacher prompts: “How can consumer awareness of the food-production process benefit food producers, consumers, and the environment?”</p> <p>“What evidence was used to support the Government of Canada’s decision to reduce the use of bisphenol A in some food packaging?” (p. 210)</p>
Grade 12	Environmental Education Resource	Food and Healthy Living – Workplace	Food	<p>“describe environmentally responsible ways of acquiring food (e.g., buying locally, bartering or exchanging, growing their own vegetables)</p> <p>Teacher prompt: “How does buying locally grown produce help the environment?”</p> <p>describe some environmentally responsible food-preparation practices (e.g., using energy efficient appliances; filling the freezer to the recommended level; using fewer pots in cooking; using a microwave oven rather than a conventional oven to cook a small amount of food; using as many parts of an item of food as possible; planning meals to avoid over shopping, eating out, or food waste)</p> <p>describe strategies they can use at home to reduce food waste and excess packaging (e.g., separating out recyclable materials, vermicomposting, using reusable fabric shopping bags, buying in bulk, refusing excess packaging)</p> <p>Teacher prompt: “What are some environmentally responsible ways of dealing with food waste and packaging?” (p. 213)</p>

Grade 10	Environmental Education Resource	Health Care – Open	Food	“identify factors that affect the personal health and well-being of children and adolescents (e.g., environmental conditions, diet, food safety, food security, adequate shelter, amount of daily exercise, amount of daily rest, recreation opportunities, work/life balance, stress)” (p. 229)
Grade 11	Environmental Education Resource	Green Industries – U/C	Food	“explain the relationships between the characteristics of different geographical regions and the key desirable characteristics of plant and/or animal groups within them (e.g., relationship of plant and animal characteristics to available heat, moisture, light, shelter, and food)” (p. 242)
Grade 11	Environmental Education Resource	Green Industries – U/C	Food	“analyse societal issues relating to the green industries, and identify ways of resolving them, taking a variety of perspectives into account (e.g., effects on Aboriginal hunting and harvesting territories, land use conflicts such as parkland versus commercial development, property rights and municipal landscape management, animal welfare, rights of migrant workers, fair trade concerns relating to imported agricultural or floral products, fuel ethanol versus food production)” (p. 244)
Grade 11	Environmental Education Resource	Hospitality and Tourism – College	Food	“explain how the relationship between food producers and food consumers affects the environment (e.g., production of organic foods in response to consumer demand results in less use of chemical fertilizers and pesticides; the Slow Food movement supports local food production and the continuing use of traditional food products; culinary tourism increases consumer awareness of and helps to support traditional food producers in many parts of the world)” (p. 256)
Grade 11	Environmental Education Resource	Hospitality and Tourism – Workplace	Food	“describe the social and economic impact of new products and technologies used in the food and beverage services sector (e.g., marketing of organic and genetically modified foods has raised consumer awareness of health and environmental issues; use of combination ovens has

				reduced labour costs and product wastage; ...)" (p. 257)
Grade 12	Environmental Education Resource	Hospitality and Tourism - Workplace	Food	"describe how the food and beverage services sector can both protect the environment and encourage the sustainable use of natural resources (e.g., by choosing new locations on or near existing infrastructure to reduce the need for new infrastructure, providing guests with the option not to have linens washed daily, composting organic waste from restaurants, reusing cooking oil as a biofuel, using locally grown produce to reduce the need for long-distance transportation)" (p. 258)