Student Interest in the WinCube Project: Assessing Variables for Student Voluntary Participation in an Extracurricular Aerospace Program

By

Jeff Cieszecki

A Thesis Submitted to the Faculty of Graduate Studies of
The University of Manitoba
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Abstract

Extracurricular science activities often provide students with unique and challenging opportunities to explore topics beyond the confines of a classroom. But what makes a student want to learn more about a science outside of a school day and what is the influence of such participation on student interest in space science? This study provides a look at a unique Manitoba aerospace extracurricular program designed for high school students called the WinCube Project (WCP). The WCP was created to provide opportunities for students to actively participate in the application of science, math, and technology and explore possible careers in the field of aerospace based on five fundamental educational goals. The source of data for this study was a high school located in Winnipeg, Manitoba. This study focuses on two key areas in regards to the WCP: what influences students to join and what keeps them involved with the program. Four research questions were developed to gain a better understanding of these issues:

1. What factors influence student initial participation in the WCP?
2. What factors influence student ongoing participation in the WCP?
3. What influences does student participation in the WCP have on future career aspirations?
4. To what degree do participants of the WCP believe the fundamental goals of the WCP have been achieved?

To evaluate the four research questions, the areas of student self-efficacy and student attitudes toward science were used as a guide. A questionnaire was completed by 100 students registered in five core grade 10 classes (Math, Geography, English, and two Science). A second group of students that were actively participating in the WinCube Project at the time of this study also completed the questionnaire and partook in a

personal interview. The questionnaire was designed to provide data for research questions one using the areas of student educational choices, family and peer influences, participation in extracurricular activities, student interests and relevance of topics, and interest in aspects of the WCP. The interview allowed WCP participants the opportunity to share their views on the project that would answer the remaining three research questions.

The results of the questionnaire and interview have provided a number of outcomes regarding the four research questions. First, the questionnaire and interview measured educational choices and the influence of family and peers. There was no significant data found that indicated that these factors had any influence on students joining the WCP. Second, students' decisions not to join the WCP may in part be affected by a lack of exposure to space-related topics in early, middle, and high school classrooms. This could impact student self-efficacy and affect a student's decision to participate in an extracurricular aerospace program. Third, ongoing participation in the WCP has been attributed to peer group development within the project, the numerous activities offered and the opportunity for students to apply what they have learned in real life applications. WinCube activities have demonstrated the opportunities for participants to explore career opportunities that related science, technology, engineering and mathematics (STEM). Last, the educational goals of the WCP are being met.

This research project provides insight into student perceptions of an extracurricular science program in Manitoba. The information gathered will help in the continued development of a program like the WinCube Project in meeting the needs of student participants.

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Chapter 1: Introduction

1.1 Introduction to the Thesis

The intent of this thesis, *Student Interest in the Wincube Project: Influences on Student Participation in Extra Curricular Aerospace Program*, is to explore the reasons why young people become involved or choose not to become involved in an informal (non-compulsory) space education program, the Wincube Project (WCP). As well, it looks at the influences of student participation in the WCP. This thesis is timely, as space education topics relating to outer space science and the utilization of space related assets have captured the imagination of students throughout all levels of study. Despite this, space science programs, both formal and informal, have a checkered history in terms of their influences on student interest in the area of space science. High school students demonstrate a curiosity and fascination about outer space, often enjoying topics related to the subject (Taylor, 2004). In Manitoba, space related topics received an overwhelmingly positive reaction to be included in, at that time, a soon to be developed high school curriculum (Rutkowski, 1991). The importance of space science education in today's science classrooms is reflected by its inclusion in the following documents:

- The Common Framework of Science Learning Outcomes (CMEC, 1997)
- Manitoba Provincial Science Curriculums:
    - Senior 1 Science (Manitoba Education and Training, 2000)
    - Senior 3 Physics (Manitoba Education and Youth, 2003)
    - Senior 4 Physics (Manitoba Education, Citizenship and Youth, 2005)
- United States' National Science Education Standards (National Research Council, 1999).

Science educators believe that it is important to inspire young learners by igniting an interest in science learning. A project like the WCP is designed to nurture that interest. But, what prevents students from becoming involved? How can a curiosity and interest be generated that promotes life long learning and potential future scientists in our technology and science world? The WCP was created with this interest in mind. The project goals provide opportunities for students to gain knowledge in science, math and technology, learn skills related to these fields and apply them to real world problems. Much of the educational opportunities offered by the WCP connect to numerous outcomes of science learning provincially and nationally. This thesis begins with an overview of the WCP and its goals and demonstrates how they are in line with the vision of provincial curricula (Manitoba Education, Citizenship and Youth, 2005; Manitoba Education and Youth, 2003; Manitoba Education and Training, 2000) and the Pan Canadian Framework (CMEC, 1997).

The literature review addresses why students choose to participate in extra curricular activities in particular their attitude to participation in science activities. The factors that may affect students' decisions to spend their free time in a science related activity will also be explored. The literature review will become the foundation for forming a hypothesis regarding why students become interested in the WCP. Chapter Three focuses on methodology and discusses why certain questions were asked based on the literature review, and the hypothesis that attempts to answer important questions regarding promoting student interest in science and the WCP. A student survey and interview were implemented to determine possible reasons students choose to be WCP participants. Finally, Chapters Four and Five will discuss the survey results. A summary of the findings will be presented in Chapter Six.

1.2 The WinCube Project

The WinCube Project (WCP) is an informal, non-compulsory space science program that provides hands-on opportunities for Manitoba high school students in the field of aerospace. Examples of components of the WCP programming include amateur radio communication, utilization of space assets, rocketry, and development of near-space and low earth orbit payloads. Learning outcomes are related to the areas of science, technology, engineering and mathematics (STEM); science, technology and society (STS); and science, technology, society and the environment (STSE). In this chapter, the educational goals of the WCP will be presented followed by a description of program offerings within the WCP. Links to Manitoba Science curriculum will also be demonstrated. Further, the intent and context of this research study will be presented along with its significance and limitations.

1.3 Educational Goals of the WinCube Project

The WCP provides an opportunity for high school students in Manitoba, to participate in scientific research utilizing near space and low Earth orbit assets. The WinCube Project's Advisory Committee has set out five fundamental goals to engage students in the field of science, math, engineering and technology as these relate to the field of aerospace:

1. Provide authentic science and innovative research learning opportunities
2. Application of high level science, math and technology
3. Enrichment for students to develop further interest in science and engineering

4. Develop collaborative opportunities with post secondary institutions and/or industry on a local, national and international level

5. Raise profile of aerospace in schools and community

(Cieszecki et. al., 2008)

To achieve these goals, the Common Framework of Science Learning Outcomes (CMEC, 1997), hereafter referred to as the Pan-Canadian Framework, was the primary curriculum foundation for the WCP. The WCP is creating "opportunities to explore, analyse, evaluate, synthesize, appreciate, and understand the interrelationships among science, technology, society, and the environment that will affect their personal lives, their careers, and their future" (CMEC, 1997, p. 4). The WCP provides participating students the chance to develop scientific attitudes, skills and knowledge through scientific payload design, construction, deployment and data recovery. Students collaborate with other high schools and mentors from local universities and industry partners. The WCP provides real life challenges for students to develop their inquiry, problem-solving, and decision-making abilities (CMEC, 1997).

The WCP also utilizes STEM, STS, and STSE concepts as they relate to the following outcomes:

- Encourage students at all grade levels to develop a critical sense of wonder and curiosity about scientific and technological endeavours
- Enable students to use science and technology to acquire new knowledge and solve problems, so that they may improve the quality of their own lives and the lives of others.
- Prepare students to critically address science-related societal, economic, ethical, and environmental issues
- Provide students with a foundation in science that creates opportunities for them to pursue progressively higher levels of study, prepares them for science-related occupations, and engages them in science-related hobbies appropriate to their interest and abilities
- Develop in students of varying aptitudes and interests a knowledge of the wide variety of careers related to science, technology, and the environment

(CMEC, 1997, p. 5)

Further, the Manitoba Provincial science curriculum's STSE general learning outcomes include:

- B1: describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies, and the environment, both locally and globally
- B2: recognize that scientific and technological endeavours have been and continue to be influenced by human needs and the societal context of the time
- B4: demonstrate a knowledge of, and personal consideration for, a range of possible science- and technology-related interests, hobbies, and careers
- B5: identify and demonstrate actions that promote a sustainable environment, society, and economy, both locally and globally

(Manitoba Education, Training and Youth, 2001, p. 4.3)

WCP students have attended numerous presentations and tours of local facilities to see and hear first hand about new science discoveries and technological breakthroughs. Students are encouraged to discuss with presenters the possible application of science discoveries, issues and new technology in their own work. Recent developments include atmospheric radiation level measurements using radiation sensitive film onboard a high altitude balloon payload and the possible inclusion of nanotechnology in balloon payload design. They are also given the opportunity to talk with engineers, scientists, and business people to learn more about the work they do in the aerospace field. By providing these opportunities, WCP students are exposed to "a range of possible science- and technology-related interests, hobbies, and careers" (Manitoba Education, Training and Youth, 2001, p. 4.3). These opportunities allow students to "pursue progressively higher levels of study", engage in "science-related hobbies appropriate to their interest and abilities" and develop "knowledge of the wide variety of careers" in science, engineering and technology (CMEC, 1997, p. 5)

It is hoped that participating students from the WCP will continue studies in the scientific field either formally as part of post-secondary coursework, or informally as a hobby, after graduating from high school. These aspirations are reflected in the WCP's goals which focus upon challenging students to look at the world around them, creating opportunities to research, and carrying out experimentation and evaluations utilizing and adapting available technology. Later in this introductory section a description of the activities offered to WCP students will be presented. The offerings provide numerous opportunities for students to demonstrate creativity in their scientific field of research.

The five educational goals of the WCP also fall within the four foundations set out by the Pan-Canadian Framework (Table 1.1).

Table 1.1: Pan-Canadian Foundations

Foundation 1: Science, technology, society, and the environment (STSE)- Students will develop an understanding of the nature of science and technology, of the relationships between science and technology, and of the social and environmental contexts of science and technology. (CMEC, 1997, p. 6)
Foundation 2: Skills – Students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively, and for making informed decisions. (CMEC, 1997, p. 6)
Foundation 3: Knowledge – Students will construct knowledge and understandings of concepts in life science, physical science, and Earth and space science, and apply these understandings to interpret, integrate, and extend their knowledge. (CMEC, 1997, p. 6)
Foundation 4: Attitudes – Students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society, and the environment. (CMEC, 1997, p. 6)

For Foundation 1: Science, Technology, Society, and the Environment (CMEC, 1997), the participating WCP students carry out authentic science research in developing mission payloads. They create plans that integrate available technologies into a scientific payload that will gather data for science objectives identified by the students. A historical development of space assets as it relates to scientific discoveries, technological breakthroughs, and societal needs is presented to the students as a foundation for their own understanding.

In Foundation 2: Skills (CMEC, 1997), WCP students are provided necessary training to develop skills for a mission. This includes computer programming, electronics, amateur radio communication and mission development. The WCP is offered to high school students across the province of Manitoba, and requires participating students from various schools to work in a collaborative manner. In Foundation 3: Knowledge (CMEC, 1997), requires students to review areas of scientific research, incorporate ideas generated into a science payload, carry out a mission and then interpret and report on their findings. Finally, in Foundation 4: Attitudes (CMEC, 1997), places upon the students in the WCP an expectation that the scientific research they carry out will go beyond a typical science lab focus found in a high school. Their mission designs will be the result of a well-researched hypothesis and sound scientific techniques in gathering data that will have an impact on scientific findings and the appropriate application of available technology.

1.4 Description of the WinCube Project

The creation of the WCP was a result of discussions among Manitoba Network for Science and Technology (MindSet), Manitoba Aerospace Human Resources Coordinating Committee (MAHRCC), and the Manitoba Satellite Interest Group (MSIG). The initial talks focused on the creation of an organization that would provide Manitoba high school students the opportunity to participate in the development, launch, and communication with a “CubeSat”. A CubeSat is a low earth orbiting satellite with a typical 10 cm x 10 cm x 10 cm structure and approximate mass of 1 kg. By the start of the WCP in 2006, initial research indicated that involving high school students in CubeSat design and construction was rare in North America, and always included technical support from either a post-secondary institution or government agency. The University of Manitoba’s Faculty of Engineering provided the WCP with technical support by having 4^{th} year engineering students participate in a Capstone Project where students looked at the design and construction of a CubeSat. The Capstone Project is an opportunity for engineering students from various backgrounds (electrical, computing, and structural) to tackle an engineering challenge as a group, in this case the creation of a CubeSat. Students would carry out theoretical research and begin testing solutions for the challenge. Their final results are presented to a panel of engineers from the university and industry for evaluation.

Initially the engineering students were to mentor the participating high school students, but it was eventually determined that the highly technical nature and rigorous testing of a CubeSat was beyond the capabilities and qualifications of the high school students. By 2008, the University of Manitoba’s Faculty of Engineering had completed two preliminary design reviews of the CubeSat’s main systems (structure, power, data processing, communication, and bus system). This allowed the high school students to focus on designing the science components of the payload. The role of the high school students in the CubeSat project further evolved in 2008 when the WCP Advisory Committee decided that high school students would form a panel to review scientific payload proposals from various faculties at the University of Manitoba. The lack of sound scientific payload components proposed by the high school students appeared to be a result of their inexperience in the field of space science research.

Since the initial inception of the WinCube Project in 2006, the program has developed six pillars of aerospace experiences for high school students in Manitoba:

1. CubeSat
2. BCube
3. Amateur Radio
4. Manitoba Space Adventure Camp
5. Ground Station
6. Introductory Aerospace Design Course

Each pillar provides varied experiences for high school students to gain a better understanding of creating and implementing a space mission. Each of these will be described in the sections to follow.

1.4.1 CubeSat

The University of Manitoba's Faculty of Engineering offered a capstone project for fourth year students in electrical, computer, and mechanical engineering (Wagener et. al., 2007, Cieszecki and Wagener, 2007). During the 2006-2007 and 2007-2008 academic years, the cohort groups developed a Preliminary Design Review (PDR) for the construction of the WinCube satellite. It has since been decided that utilizing a capstone style project for fourth year engineering students was not working. Since there was no carry over of engineering students from one year to the next, the CubeSat design and construction has now expanded to include both undergraduate and graduate students (Kinsner, 2008). Initially, the collaboration between high school students and the fourth Year University of Manitoba's Faculty of Engineering graduate students was to take on the form of a mentorship program. Student's from various high schools identified their interest in the various design and construction aspects of the WinCube satellite and would be mentored by graduate students from the university who specialize in that particular area of engineering. Opportunities provided for high school students would include regular visits to the Faculty of Engineering to access resources and professional guidance in the design and construction of the satellite. A contingent of high school students would also meet with the engineering students and attend industry sponsored lectures (Wagener et. al., 2007, Cieszecki and Wagener, 2007). However, the process of establishing meetings between high school and university students was slow to develop, with the two levels of students meeting only formally once and informally twice in two years.

In early 2009, the WCP Advisory Committee began working on a new mentorship model between the university and high schools that would see high school students develop skills through the various WCP pillars that would parallel research work carried out at the University of Manitoba. Such work involved activities such as near space testing of CubeSat components on high altitude balloon and ground station communications with orbiting satellites.

1.4.2 BCube

The level of complexity and construction requirements for the design and launching of a satellite required the inclusion of a secondary project within the larger WCP. The BCube Project has high school students design and launch scientific payloads attached to high altitude research balloons. The process of designing, constructing, and testing a balloon payload parallels the process of the WinCube CubeSat, providing a less stringent environment for students to gain initial experience in mission design. Technical support in the development of the BCube Project was provided by the Space Studies Department at the University of North Dakota. A series of presentations by faculty and alumni from the Space Studies Department to WCP project leaders occurred in preparation for the construction of the Manitoba balloon payloads. Students from Manitoba visited the launch of payloads designed by high schools in North Dakota in April of 2007 (Wagener et. al., 2007, Cieszecki and Wagener, 2007).

In July, 2007, the WinCube Project launched its first high altitude balloon payload at the Manitoba Space Adventure Camp. The payload's onboard science component consisted of a digital camera that took images of the Earth (remote sensing). During the flight, participating high school students tracked the position of the satellite using amateur radio frequencies and computer tracking software. Unfortunately, during the hour long ground search for the balloon payload based on its last received GPS location, the students were not able to locate the payload. It is hoped that eventually members of the general public will locate and return the payload.

A second student payload was launched on October 29, 2008 from Maples Collegiate in Winnipeg. The time of flight was set for 60 minutes before the payload separated from the balloon. The payload reached an altitude of 14, 058 metres (46,122 ft). The payload was recovered near Piney, in Southwestern Manitoba, 160 km from its original launch point. The onboard digital camera recorded images of the ground throughout the flight.

The tracking of the BCube payloads is done through transmission of GPS coordinates from the payload using amateur frequencies and repeater systems. High school students who have participated in the WCP amateur radio course tracked the payloads. The skills and experience high school students learn in BCube payload components design like structure, communication, onboard programming, electrical, can be applied to the near space laboratory work the graduate students at the University of Manitoba carry out. Similar payload concepts as those utilized in the BCube project are practiced in the near space laboratory to test the space readiness of the CubeSat components. High school students could then participate in the testing carried out in the University of Manitoba's near space lab, tracking and retrieval of the universities balloon payloads.

1.4.3 Amateur Radio

The amateur radio course was offered to high school students on a series of Saturdays at one of the participating high schools in Winnipeg. The course followed a curriculum prepared by the Radio Amateurs of Canada (RAC). Students outside the city including students from a northern Manitoba community participated in the class via the internet. Amateur radio frequencies are used in the communication and tracking of satellites and high altitude balloon payloads. For students to fully participate in these activities, they are required to participate in the WinCube Amateur Radio Course (Wagener et. al., 2007, Cieszecki and Wagener, 2007).

1.4.4 Manitoba Space Adventure Camp

The initial Manitoba Space Adventure Camp (MSAC) took place in July, 2006. The camp was held at the School of Aerospace at the 17th Wing Air Command Base in Winnipeg. The WCP invited three students from each participating high school. Topics presented by Canadian Armed Forces specialists included space history, space mission design, orbital mechanics, space environment, and communications. The Manitoba High

Powered Rocketry Association provided launch demonstrations of some of their rockets. Students also constructed and launched small, commercially produced rockets.

The following is a brief list of MSAC offerings over the past three years as they relate to STEM, STS, and STSE:

Scientific and technological endeavours/developments:

- CubeSat concept
- Orbital mechanics
- Satellite ground station
- Remote sensing from space
- Nano-fabrication
- Rapid prototyping

Science/technology related issues:

- Zero gravity experimentation
- Global Positioning System (GPS)
- Satellite design
- Amateur radio
- Satellite communication
- Space law

Occupations and hobbies:

- Rocket construction and launch
- Amateur radio
- Geo-Caching
- Space business
- Engineering as a career
- Tour of Magellan Aerospace satellite facility

In July of 2007, the camp was offered again including an introductory level that was similar to the one in 2006, along with an advanced camp that specifically focused on issues relating to the construction of the WinCube satellite. The 2007 also included a student radio contact with an astronaut onboard the International Space Station (Wagener et. al., 2007, Cieszecki and Wagener, 2007).

1.4.5 Ground Station

The WinCube Ground Station (WinGS) was created to allow high school students to communicate with their CubeSat once it is launched into space. By the end of October, 2008, WinGS became operational at its location at the University of Manitoba's Engineering and Information Technology Complex. The system consists of a cross-polarized Yagi-Uda antenna complete with satellite tracking software. "The primary objective of the ground station is to provide a facility for data and voice communications with LEO satellites through amateur radio bands (2 m and 70 cm)" (Kinsner, 2008, p. 1). The station will allow 24 hour access, 7 days a week, for participants of the WCP to carry out various research and communications such as Amateur Radio on the International Space Station (ARISS), Ground-station Educational Network for Spacecraft Operations (GENSO), tracking of high altitude balloons launched by WCP students and the Prairie Near-Space Exploration Laboratory. "The anticipated outcome of the station is the improved hands-on experience opportunities for our undergraduate engineering students, and an improved outreach to our high school and primary schools in Manitoba and elsewhere" (Kinsner, 2008, p. 1).

WinGS will also become an integral part of the BCube launches and Near-Space Exploration Laboratory in the coming years:

> The ground station {WinGS} can track payloads to be launched by the Near-Space Exploration Laboratory at the University of Manitoba that is being developed. The payloads will carry various experiments related to the WinCube projects. There is also interest from industries to test their electronic components and subsystems in near-space conditions (e.g., temperature, pressure, radiation). (Kinsner, 2008, p. 6)

During the summer of 2007, the WCP became aware of the GENSO project at the Small Satellite Conference in Logan, Utah. With the possible participation of the WCP in GENSO, the opportunities for high school students are truly unique:

> The ground station (WinGS) can provide a near-global telemetry facility for the Global Educational Network for Spacecraft Operations (GENSO). GENSO is aimed at CubeSat operations and Amateur Satellite (AmSat) users to provide worldwide opportunities for telemetry recovery by error correction (multiple data streams). GENSO is an initiative sponsored by the International Space Education Board (ISEB), consisting of the education departments of the European Space Agency (ESA), the Canadian Space Agency (CSA), Centre National d'Etudes Spatiales (CNES), the Japan Aerospace Exploration Agency (JAXA), and the National Aeronautics and Space Administration (NASA).
>
> (Kinsner, 2008, p. 5)

WinGS would become part of an international organization that would be able to primarily download telemetry data from existing orbiting CubeSats for other educational institutions around the world. The GENSO representative at the Small Satellite conference in 2007 expressed interest about involving high school students in the project. A second major project that WinGS is anticipated to become part of is the ARISS (Amateur Radio on the International Space Station) Program.

ARISS is an international project where students from around the world communicate with astronauts onboard the International Space Station (ISS) using amateur radio. In July, 2007, 10 students attending the Manitoba Space Adventure Camp had the opportunity to talk to Clayton Anderson, an American astronaut onboard the ISS as part of the ARISS program.

> The maximum elevation of the ISS was 70 degrees and the contact lasted for over 9 minutes. Astronaut Clayton Anderson answered 18 questions on a variety of issues, and some of {the}students who took part in the 2006-07 amateur radio class had their first ISS QSO as certificate holders.
>
> (Wagener et. al., 2009, p. 13)

The WCP is expecting to become a Telebridge for the ARISS Program sometime in 2009. The Telebridge concept would involve the WinCube ground station to make initial contact with the ISS using amateur frequencies, and then link the ISS with schools from around the world using either internet communication or telephone lines. Participating students in the WCP who have taken the amateur radio course will be allowed to participate in the operation of the ARISS Telebridge.

1.4.6 Introductory Aerospace Design Course

The Introductory Aerospace Design Course (IADC) is a learning opportunity for second year WCP participants. Coursework includes further development of theory and concepts involved in space mission design and engineering. Topics include general process of space mission development including examination of mission requirements examining options, constraints and tradeoffs. These areas of mission design are all applicable to student involvement in BCube or CubeSat payloads. Students attend presentations and participate in hands-on activities such as Analytic Graphics' (AGI) Satellite Toolkit (STK) and structured briefings involving different system architectural designs (Cieszecki et al., 2008).

1.5 Authentic Science and Innovative Research Opportunities

Initial research has shown that involving high school students in the design and construction of a CubeSat is rare in North America. The WCP has been developing the CubeSat portion of the project to have Manitoba high school students included in the small satellite mission at the University of Manitoba. The original goal of the WCP was to have Manitoba high school students build and launch a CubeSat. As the WCP proceeded, the WinCube Advisory Committee determined the level of complexity and rigorous requirements to launch a CubeSat as beyond the skills and knowledge of the high school students. The WCP Advisory Committee decided to turn the responsibility for the CubeSat mission over to the Faculty of Engineering at the University of Manitoba.

The WCP has evolved over the last four years, to include six pillars of education for participating high school students. Each pillar provides the opportunity for students to engage in authentic science and innovative research opportunities that parallel the work done in the CubeSat mission at the University of Manitoba. For example, the Prairie Near-Space Exploration Laboratory will use high altitude balloons to test the space readiness of components for the CubeSat mission. WCP students have gained valuable knowledge in this area having launched their own BCube missions.

High school students have experience in space mission design through their participation in the WCP Introductory Aerospace Design Course (IADC), Manitoba Space Adventure Camp, and other various workshop offerings. Subsystems onboard a CubeSat are similar in concept as on a BCube. They include:

- Structure
- Electrical power
- Communication systems
- Command and data handling
- On-board science
- Integration and testing

For the command and data handling on the BCube payloads, WCP students use pBasic programming language utilizing a Stamp chip that controls the cut down device for the payload and operation of science components like an onboard digital camera.

1.6 WCP Links to the Pan-Canadian Framework

A major area of work completed by the WCP participants is the design, construction, launch and retrieval of a high altitude balloon payload (BCube). The skills learned in the BCube component provide students with a sound background in payload design concepts. In order to create a BCube, a number of skills must be developed by the participants. To provide the necessary learning opportunities, the WCP uses the Pan-Canadian as its framework for its curriculum. The General Learning Outcomes (GLOs) are found in Table 1.2.

Table 1.2: General Learning Outcomes: Skills

By the end of grade 12 It is expected that students will…
Initiating and Planning 212 ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues Performing and Recording 213 conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information Analysing and Interpreting 214 analyse data and apply mathematical and conceptual models to develop and assess possible explanations Communication and Teamwork 215 work as a member of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results (CMEC, 1997, p. 195)

Using the four GLOs as they relate to skills, a key component is Communication and Teamwork (GLO 215). WCP participants are from various high schools throughout Manitoba and must work together as a team throughout the BCube mission. They are required to Initiate and Plan (GLO 212) the mission, and design the payload. The payload must contain a science component capable of gathering data (Performing and Recording – GLO 213). When the payload is recovered, the students will Analyse and Interpret their findings (GLO 214) and Communicate the results (GLO 215). For Specific Learning Outcomes (SLOs) utilized by the WCP, please refer to Appendix A of this work.

The GLO 215, Communication and Teamwork is a fundamental goal not only for the students involved in the project who are partnered with students from various high school in Manitoba, but for the participating teachers as well. Each teacher contributes to the strong knowledge base utilized in designing the structure of the program. It is the spirit of 'cooperation' rather than 'competition' that the progress of this project is made possible. By having the teachers "work as a member of a team" (CMEC, 1997, p. 195) in developing ideas, each teacher serves as a role model for their students. Students are also expected to work as a team not only in their own schools, but also with other schools within the larger framework of the overall project. Cross high school collaboration includes attendance of WCP sessions such as:

- Manitoba Space Adventure Camp
- Electronics workshops
- Presentations and tours at the University of Manitoba's Faculty of Engineering

Each of these provide an opportunity for student networking which it is hoped will further develop into team building among all students within the program. The WCP has established five educational goals that have been created to provide Manitoba high school students with unique opportunities in the field of aerospace research. The six pillars of aerospace experience set up to support the WCP goals delivers learning opportunities that incorporate the four Pan-Canadian Foundations for student learning (CMEC, 1997, p. 6).

1.7 WCP Links to the Manitoba Science Curriculum

The WCP has a number of GLO and SLO curriculum links to the Senior Years Manitoba science curriculum. For a detailed listing of specific outcomes, refer to Appendix B of this work.

1.7.1 General Learning Outcomes

The Province of Manitoba has five GLO it utilizes for its Early, Middle, and Senior Years science curriculums:

- GLO A: Nature of Science and Technology
- GLO B: Science, Technology, Society, and the Environment (STSE)
- GLO C: Scientific and Technological Skills and Attitudes
- GLO D: Essential Sciences Knowledge
- GLO E: Unifying Concepts

(Manitoba Education, Training and Youth, 2001, pp.4.3-4.5)

For GLO A, the Nature of Science and Technology, WCP participants are shown the historical development and relationships between science and technology as they apply to space assets. The primary driver for space asset development is a reflection of societal demands, which leads to the link to GLO B, Science, Technology, and the Environment. Students see first hand leading edge technological and scientific developments and the possible career opportunities they provide.

GLO C, Scientific and Technological Skills and Attitudes is a reflection of student participation in a BCube payload mission as described in section 1.4.2 of this chapter. GLO D, Essential Science Knowledge and GLO: Unifying Concepts, incorporates CubeSat payload launch and the orbital mechanics of a mission. The BCube project (as well as the CubeSat) provides an opportunity to study the Earth's atmosphere and hydrosphere.

An example of Manitoba curricula links to the WCP is demonstrated through the Amateur Radio Course. Specific topics covered by ARC and the links to the grade 11 and 12 physics curriculum are displayed in Table 1.3.

Table 1.3: Amateur Radio Course Links to Manitoba Curricula

ARC Performance Indicators	Physics Specific Learning Outcomes
• Properties of waves • Electromagnetic waves • Classification of waves • Ionosphere • Impact of solar activity • MF/HF/VHF/UHF propagation • Antennas • Scattering • Atmospherics	Grade 11 Physics: Waves in one dimension • Properties of waves • Transmission and interference of waves • Communication Technologies Waves in two dimensions: • Wave fronts • Interference of waves Particle and Wave Models of Light: • Light as electromagnetic wave
• Inductance • Capacitors • Inductive reactance • Inductive reactance • Radiation patterns • Antenna design	Grade 11 Physics Magnetic Fields: • Field lines • Earth's magnetic field Electromagnetism: • Electric/magnetic fields • Function of electromagnets
• Current/Voltage/Resistance • Conductance/insulators • AC/DC currents • Ohm's law • Resistors in series/parallel • Power • Inductors in series/parallel • Resonance • Transmission lines • Transistors • Integrated circuits • Voltage regulation • AC/DC conversion	Grade 12 Physics: Electric Fields: • Electric charge • Electric Potential Electric Circuits: • Ohm's law • Parallel/Series circuits • Resistance/current/voltage/power

It is clear from Table 1.3 that the ARC provides a context for students to apply their theoretical knowledge of waves and electromagnetic phenomena. All of the topics covered in the ARC are directly applied to amateur radio equipment and its use in communication.

Appendix B also contains Prescribed Learning Outcomes (PLOs) that lend themselves to the WCP. Table 1.4 highlights key PLOs in the Manitoba science curricula links. A brief description of each PLO and examples of WCP performance indicators are highlighted. Specific courses include Grade 9 (Senior 1 Science), Grade 10 (Senior 2 Science), Grade 11 and 12 Physics (Senior 3 and Senior 4 respectively). For each PLO described in Table 1.4 the WCP activity that explores those concepts are also presented.

Table 1.4: WCP Performance Indicator Links to Prescribed Learning Outcomes of Manitoba Science Curricula

	Senior 1	Senior 2	Senior 3 Physics	Senior 4 Physics	WinCube Pillars
Exploring Space: • Impact/development of technologies • Canada in space • Kepler's laws • Escape velocity WCP Performance Indicators: • Historical development of space assets • Demonstrations of technologies • Use of computer simulations for orbital mechanics	√				CubeSat MSAC IADC
Kinematics: • Velocity, displacement, acceleration WCP Performance Indicators: • Use of computer simulations for orbital mechanics • Tracking of BCube and CubeSat • Wave transmission calculations		√	√	√	CubeSat BCube MSAC ARC WinGS IADC
Dynamics: • Newton's Laws • Force and kinematics • Free body diagrams WCP Performance Indicators: • Rocket delivery systems • Construction and launch of student rockets • Thrust, impulse		√	√	√	CubeSat MSAC IADC

Table 1.4: WCP Links to Prescribed Learning Outcomes of Manitoba Science Curricula and WCP Performance Indicators (Continued)

	Senior 1	Senior 2	Senior 3 Physics	Senior 4 Physics	WinCube Pillars
Weather: • Earth's atmosphere • Weather dynamics • Climate change WCP Performance Indicators: • Use of space assets for climate change detection • Weather satellite downlinks • Mission designs • Atmospheric affects on radio transmissions		√			CubeSat BCube MSAC ARC IADC
Waves in one dimension • Properties of waves • Transmission and interference of waves • Communication Technologies Waves in two dimensions: • Wave fronts • Interference of waves Particle and Wave Models of Light: • Light as electromagnetic wave WCP Performance Indicators: • Radio transmission/reception • Amateur radio hardware and its operation • Atmospheric issues • Mission application of amateur radio • Satellite communication			√		CubeSat BCube MSAC ARC WinGS

Table 1.4: WCP Links to Prescribed Learning Outcomes of Manitoba Science Curricula and WCP Performance Indicators (Continued)

	Senior 1	Senior 2	Senior 3 Physics	Senior 4 Physics	WinCube Pillars
Gravitational Fields: • Earth's gravitational field • Mass vs. weight • Free fall/terminal velocity WCP Performance Indicators: • Computer simulations of orbital mechanics • Implications for rocket launches • Descent rates for payload recovery			√		CubeSat MSAC IADC
Magnetic Fields: • Field lines • Earth's magnetic field WCP Performance Indicators: • Research on effect of Earth's magnetic • Impact of magnetic field on satellites • Magnetic fields and amateur radio equipment • Magnetic fields and radio transmissions			√		CubeSat MSAC ARC WinGS IADC
Electromagnetism: • Electric/magnetic fields • Function of electromagnets WCP Performance Indicators: • Space environment • Electric/magnetic fields in radio equipment • Electric/magnetic fields and orbiting satellites • Electromagnetism and radio transmissions – antennae use			√		CubeSat MSAC ARC WinGS IADC

Table 1.4: WCP Links to Prescribed Learning Outcomes of Manitoba Science Curricula and WCP Performance Indicators (Continued)

	Senior 1	Senior 2	Senior 3 Physics	Senior 4 Physics	WinCube Pillars
Momentum: • Impulse • Conservation of momentum WCP Performance Indicators: • Rocketry • Space debris and satellite safety				√	CubeSat MSAC IADC
Projectile Motion: • Free fall • Projectile motion analysis WCP Performance Indicators: • Satellite launches • Payload recovery				√	CubeSat BCube MSAC IADC
Circular Motion: • Acceleration towards centre • Centrifugal force • Velocity, acceleration WCP Performance Indicators: • Orbital mechanics • Computer simulations of orbits • Molniya/ geosynchronous/ Geostationary / Sun synchronous / polar orbits				√	CubeSat MSAC WinGS IADC
Work and Energy: • Defining work • Transfer of energy • Conservation of Energy WCP Performance Indicators: • Launching of rockets • Orbital transfers				√	CubeSat MSAC IADC

Table 1.4: WCP Links to Prescribed Learning Outcomes of Manitoba Science Curricula and WCP Performance Indicators (Continued)

	Senior 1	Senior 2	Senior 3 Physics	Senior 4 Physics	WinCube Pillars
Low Earth Orbit: • Law of Universal Gravitation • Microgravity • Orbits WCP Performance Indicators: • Satellite orbits • Affect of microgravity on equipment • Experiments in microgravity • Rocket launches • Orbital mechanics • Computer simulations of orbits • Molniya/ geosynchronous/ Geostationary / Sun synchronous / polar orbits • Satellite tracking				√	CubeSat MSAC WinGS IADC
Electric Fields: • Electric charge • Electric Potential WCP Performance Indicators: • Electric charge use in radio equipment • Affect of electric fields on payload designs • Electric fields and radio transmission patterns				√	CubeSat MSAC ARC WinGS

Table 1.4: WCP Links to Prescribed Learning Outcomes of Manitoba Science Curricula and WCP Performance Indicators (Continued)

	Senior 1	Senior 2	Senior 3 Physics	Senior 4 Physics	WinCube Pillars
Electric Circuits: • Ohm's law • Parallel/Series circuits • Resistance/current/voltage /power WCP Performance Indicators: • Payload circuitry • Radio schematics • Power issues in payload design • Impedance matching in antennae design				√	CubeSat BCube MSAC ARC WinGS

Table 1.4 indicates the vast array of topics presented at MSAC and the knowledge needed for a CubeSat mission. The Manitoba science curriculum links described in Table 1.4 relate to payload construction and atmospheric research. The column relating to Radio includes both the amateur radio course and WCP ground station that corresponds to topics of amateur radio certification and satellite communication.

1.8 Research Questions

The WCP has created a number of unique learning opportunities for Manitoba high school students incorporating the WCP's five educational goals as a guide. The WCP Advisory Committee has made numerous recruitment drives for the program, with participation varying during the life of the project. In the first year, there were participants from seven high schools in Manitoba, two from outside the City of Winnipeg. In the second year, the number of schools dropped to five, including two new schools to the program. In 2009, there were three schools committed to the project.

When members of the WCP Advisory Committee make presentations at various high schools, the audience is extremely interested in the WCP, but few students register for the program, and even fewer remain. Even recruitment from within participating high schools is low given some of their populations are in excess of 1,000 students.

The focus of this research project is to better understand the influences of student participation in the WCP at Maples Collegiate, one of the high schools that has participated in the WCP for all three years that the project has operated. The focus is both on why students come to participate in the program and the influences of the program on those that decide to participate. The number of students participating from this school of 1200 students in the WCP has averaged eight per year, with four that have been involved for all three years. This study also attempts to determine why only a small fraction of the student population becomes involved in the WCP and whether or not the WCP's educational goals have been achieved. The specific research questions are:

1. What factors influence student initial participation in the WCP?
2. What factors influence student ongoing participation in the WCP?
3. What influences does student participation in the WCP on future career aspirations?
4. To what degree do participants of the WCP believe the fundamental goals of the WCP have been achieved?

Since this program evaluation focuses upon only one school in which the WCP operates, a case study methodology will be used. In line with case study research a variety of data sources will be used. The first part of this research project will target six grade 10 classes at the participating high school and gather their responses pertaining to participation in the program with a written questionnaire. The sample will include students who are likely to have heard about the WCP in the school by their teachers. The second part of the study asks students that have participated in WCP activities to complete the questionnaire and participate in a personal interview relating to their experience in the WCP.

Question 1 is primarily addressed through the use of the questionnaire (Appendix C) and will look at the factors that might influence student participation in the WCP. Factors include student self-efficacy, peer and home influences, student interest in science, and involvement in extracurricular activities.

Questions 2, 3, and 4 will be addressed through the second part of this research project, the personal interview. Question 2 will provide data that will give insight into the ongoing interest held by participating students of the WCP. Question 3 will determine if the WCP approach to STEM, STS, and STSE exposure has had any effect on future careers or hobbies in science, technology or engineering. Question 4 will provide feedback on whether or not the five fundamental goals of the WCP are being met.

1.9 Significance of the Study

The WCP has tried to raise the profile of aerospace in schools and the community by providing Manitoba high school students with the opportunity to engage in science, math and technology activities (Cieszecki et. al., 2008) through its six program offerings. These activities and innovative research opportunities for students are an attempt to encourage STEM, STSE, and STS ideals of investigating careers and hobbies in the fields of science, technology, and engineering. For those schools that have participated in the WCP, only a small fraction of the school's population has actively participated. This research project is intended to provide some insight into why greater numbers of students do not become involved in the WCP. Data gathered will provide information on the background of the targeted grades for this aerospace program. By combining the information gathered by research question 1 with the feedback provided by students during the interview portion of this research project, a possible adjustment to WCP program offerings and educational goals will improve the WCP program delivery. The results may also help other groups who are already offering or are considering establishing a similar program.

1.10 Limitations of the Study

The study is limited to one school in which the WCP currently operates. By so doing, the study lacks a full representation of those schools and students who could contribute to the focus of this study. As well, the sample size used in the questionnaire (Appendix C) component of this project will be limited to approximately 8% of the school population and only at the grade 10 level. The school has a student population of approximately 1200 students and has grades 9 to 12. Although the school has an ethnically diverse student population with the majority coming from middle class backgrounds, the questionnaires and interviews will not address other socio-economic backgrounds likely to be associated with other WCP contexts. As suggested by many researchers (e.g. Yin, 1994) case studies lack generalizability. However, the results from this research project will help to develop the WCP project at the targeted school and provide insight into extracurricular science offerings at other schools.

The student group that will partake in the individual interviews will be open to all past and present participants of the WCP. It is hoped some insight into questions 2 to 4 will be provided during this process. Unfortunately, there is no guarantee that students no longer with the WCP will participate in the interviews, leaving out critical data of what did not appeal to their interests and had them to leave the WCP.

Finally, the study only includes the participation of students. WCP participating teachers were not consulted for this thesis. The researcher was aware of teacher opinions having worked closely with them for the past three years on the WCP. It was decided to focus on student input since the student perspective had not yet been polled since the inception of the WCP.

1.11 Summary

In this chapter I have provided a brief background of the WCP including its five educational goals and its six pillars of educational programming. WCP curriculum links to the Pan-Canadian Framework and Manitoba Science curricula were provided. The four research questions of this project and its significance and limitations were presented. In the next chapter, a literature review will be conducted reviewing areas of self-efficacy, student attitudes toward science, and the influence of family, peers, interest and relevance as it relates to extracurricular activity participation.

Chapter 2: Literature Review

2.1 Introduction

This thesis focuses upon student participation in a voluntary space science program. Since the study focuses on influences of student participation in the WinCube Project (WCP), it is valuable to examine literature pertaining to extracurricular activities and adolescent participation in extracurricular activities.

Approximately 40% of an "adolescent's waking hour are discretionary (no school, homework, employment, or chores)" (Eccles & Barber, 1999, p. 39). Eccles and Barber (1999) found in a survey of grade 10 students that 69% of those surveyed had participated in at least one extra-curricular activity. Of those that participated, females participated in more and a wider variety of extracurricular activities (prosocial, performing arts, and school involvement activities) than their male counterparts who were more likely to engage in at least one sport activity (pp. 16-17). Gadbois and Bowker (2007) found in their study sample of grade 11 students that 98.5% of those students participated in some form of extracurricular activity. In the same survey, 93% said they were involved in an athletic activity and 77% participated in both athletic and non-athletic activities (83% of girls, 65% of boys). In their review of studies on student participation patterns, Feldman and Matjasko (2005) found that sports are the most popular extracurricular activity. From these survey results, there seems to be some interest in high school participation in extracurricular activities.

There are a number of factors that influence a student's use of their "free time" in a manner that suits their needs. Extracurricular curricular activities may only be a small part of an individual's life:

> Extracurricular activities may be one part of the micro system that adolescents can actively select to fit their own dispositions and talents. Hence, participation may offset the effects of a lack of fit with other proximal contexts, and it may even enhance the positive effects and good fits in these areas
> (Feldman & Matjasko, 2005, p. 196)

This project will look at some of the possible reasons an individual might or might not join an extracurricular activity like the WCP. Attitudinal predictors of student choices can be drawn from the Expectancy-Value Model of Achievement Choices that "links achievement-related beliefs, outcomes, and goals to causal attributional patterns, to the input of socializers (primary parents and teachers) … to self perceptions and self-concepts, and to one's perceptions of the task itself" (Updegraff et al., 1996, p. 240). Predictors of student choices for extracurricular activities can be drawn from this model. It is important to note that extracurricular activities can have on a student's future decisions:

> The adolescent years represents a critical period in human development during which young people work toward establishing independence and during which contexts outside the family become more important. The choices adolescents make and the opportunities made available to them during this critical period may have lifelong implications for their emotional and physical well-being.
> (Feldman & Matjasko, 2005, p. 191)

In this research project, the WCP is offered as an extracurricular activity in the school being surveyed. This literature review sets out to define the type of extra-curricular activity the WCP is in relation to other available activities. Choice of activity will be related to student self-efficacy, attitudes toward science, family and peer influences, subject relevance, student interest, and gender.

2.2 Defining the WinCube Project

The WCP has been offered in a variety of capacities in Manitoba high schools. The WCP is offered to students primarily as an extracurricular activity (some schools incorporate content directly into their classrooms). For the school participating in this study, the WCP is exclusively extracurricular.

Organized extracurricular activities can be classified into one of five major categories:

1. **Prosocial activities** – attending church and/or participating in volunteer and community service type activities
2. **Performance activities** – participating in school band, drama, and/or dance
3. **Team sports** – participating in one or more school teams
4. **School involvement** – participating in student government, pep club, and/or cheerleading
5. **Academic clubs** – participating in debate, foreign language, math or chess clubs, science fair, or tutoring in academic subjects

(Eccles & Barber, 1999, p. 14)

All five categories can be thought of as constructive or organized leisure activities that are "supervised to some degree" by adults, is "highly structured" and provides high school participants with a "clear set of activities in which to engage" (Agnew & Peterson, 1989, p. 335). It also "requires effort and provides a forum in which to express one's identity or passion in sports, performing arts, and leadership activities" (Eccles & Barber, 1999). Other activities students can participate in may be classified as relaxed leisure activities that are "characterized as enjoyable, but not demanding" such as watching TV (Eccles & Barber, 1999, p. 11). The WCP is then classified as a constructive leisure academic club. Agnew and Peterson (1989) found that constructive leisure activities "may increase attachment to school and other conventional organizations, increase commitment to conventional activities, function as attractive alternatives to delinquency, foster conventional beliefs" (p. 335). Extracurricular activities "provide settings within the school where adolescents can interact with peers, participate in activities of common interest which offer both challenge and enjoyment, and be supervised by supportive adults" (Fredericks & Eccles, 2005, p. 518). There are many extra-curricular options available to students in the targeted school, so what would make the WCP appealing for students?

The five categories of constructive leisure activities are included in this work to establish other extra-curricular activities high school students may encounter. There major categories were included in this study because "they require effort and are settings in which adolescents can express their identities and passions" (Eccles & Barber, 1999, p. 13). Constructive leisure activities also have "beneficial development outcomes for adolescents" (Eccles & Barber, 1999, p. 11):

- To acquire and practice specific social, physical, and intellectual skills that may be useful in a wide variety of settings
- To contribute to the well-being of one's community and to develop a sense of agency as a member of one's community
- To belong to a socially recognized and valued group
- To establish supportive social networks of both peers and adults that can help one in both the present and the future
- To experience and deal with challenges

(Eccles & Barber, 1999, pp. 11-12, Eccles & Templeton, 2002, p. 121)

Of the five beneficial development outcomes listed, the key areas that apply to the WCP are the acquisition and application of intellectual skills, becoming a part of a valued group, creation of social networks, and experiencing challenges. In Chapter One, the educational experience students' gain in the WCP are described in detail and applies to intellectual skill development and experiential challenges. The work accomplished by WCP participants has been recognized and valued by their peers, teachers, parents and members of post-secondary institutions, government, and industry as told to the researcher of this project. The researcher has also observed the social bond that develops between WCP students within and between participating schools.

The questionnaire used in this project will attempt to gauge what activities the students at the targeted high school participate in. But not all activities offered are seen the same by the students:

> Not all extracurricular activities share the same characteristics. Activities such as sport, cheerleading and debate involve close supervision by a coach or sponsor, take place several times a week, involve competition, and usually comprise a consistent group of students. In contrast, activities such as foreign language clubs, math and history clubs, and the National Honor Society typically comprise large student groups with higher turnover rates, take place less often (monthly as opposed to daily or weekly), and involve less contact with the sponsor.
> (Feldman & Matjasko, 2005, p. 194)

The WCP falls under the latter description of activity characteristics described by Feldman and Matjasko. WCP activities can be as regular as meeting every second week for an amateur radio class to once every few months for an activity involving the CubeSat. From a student perspective, why they stay with the WCP rather than join another activity will be addressed in the individual interviews held with participants:

> ...activity characteristics may differ according to school and community, but it remains that activities are qualitatively different from each other as well, and this may lead to differentiated outcomes among their participants.
> (Feldman & Matjasko, 2005, p. 194)

The WCP is classified as an academic club. The questionnaire used in this research project will provide insight in where students at the targeted high school spend a majority of their time in the five major categories of prosocial, performance, team sports, school involvement, or academic clubs.

2.3 Extracurricular Choices

Student choices of extracurricular activities can provide some insight into a student's self-identity. Eccles and Barber (1999) found a link between a student's self-identity and their patterns of activity involvement amongst other indicators of successful adolescent development. In surveying potential WCP students, the questionnaire portion will set out to try and evaluate student participation in the five activity categories identified in section 2.2. The choice of activity "is likely to both grow out of and reinforce emerging identities – particularly those aspects of identity linked to instrumental success and finding one's place in the social milieu" (Eccles & Barber, 1999, p. 39).

A parallel can be drawn between student choice of extracurricular activity and enrollment in optional courses at school:

> … people will be most likely to enroll in courses that they think they can master and that have high task value for them. Individuals' expectations for success (and a sense of domain-specific personal efficacy) depend on their confidence in their intellectual abilities and on their estimations of the difficulty of the course. These beliefs have been shaped over time by their experiences with the subject matter and by their subjective interpretations of those experiences (e.g., do people thing that their successes are a consequence of high ability or lots of hard work?).
>
> (Eccles, 1994, p. 589)

Extra-curricular choices can be influenced in a similar manner as those described by Eccles (1994) in optional course enrolment. Further choice in participating in a course or extracurricular activity can include such factors as:

- Does the individual enjoy the subject material?
- Is the activity (course) seen as meeting long- or short-term goals?
- Are people (teachers/parents/peers) encouraging the student to join the activity (course)?

(Eccles, 1994)

These issues can affect what extracurricular activities a student participates in and will be discussed in the next few sections of this chapter.

Student achievement-related choices are made consciously or non-consciously and can impact the probability an individual will select a particular activity over another

(Eccles, 1994). In evaluating their options for joining an activity, some of the evaluative processes can include the following:

- one's expectations for success in, and sense of personal efficacy for, the various options;
- the relation of the options both to one's short- and long-range goals and to one's core self-identity and basic psychological needs;
- the potential cost of investing time in one activity rather than another (Eccles, 1994, pp. 591-592)
- intrinsic interest in, and enjoyment of, the task;
- attainment value, or the value an activity has because engaging in it is consistent with one's self-image;

(Eccles, 1994, p. 596)

High school students will for the most part participate in extra-curricular activities. In a study conducted by Eccles and Barber (1999), 69% of grade 10 students surveyed had participated in at least one extra-curricular activity. Gadbois and Bowker (2007) found in their study sample of grade 11 students that 98.5% of those students participated in some form of extracurricular activity. Those students who do participate in extra-curricular activities will choose between "two or more positive options or between two or more options that have both positive and negative components" (Eccles, 1994, p. 591). Students will become involved in extra-curricular activities. This study will address how to make their choice include the WCP as an option.

The literature suggests that students need to be effectively informed about an activity to select it as an option. A critical issue for the WCP recruitment is how students are informed about the project. Typically WCP Advisory Committee members approach high school teachers who share information with their students. In the school that is the focus of this study, students have been informed through information posters provided to Teacher Advisor classes and in some cases individual contact with students by the cooperating WCP teacher at the school. The potential for students to join the WCP over other activities may be lost if the description of the WCP is not effective enough:

> Although individuals do choose from among several options, they do not actively, or consciously, consider the full range of objectively available options in making their selections. Many options are never considered because individuals are unaware of their existence. Other options are not seriously considered because individuals have inaccurate information regarding either the option itself or the possibility of achieving the option.
>
> (Eccles, 1994, p. 589)

Every Teacher Advisor in the targeted school has been provided information about the WCP to share with their students. The teachers have also heard presentations about the WCP, so they have a basic idea of the WCP components. What the questionnaire will gauge is whether or not students even realize the school offers WCP opportunities for participation.

Another issue that can affect student participation in an extracurricular activity is whether they are new to a school:

> When students have just started at a particular school or with a study subject with which they have no or hardly any experience, they usually have little knowledge of the task requirements and therefore little understanding of what is expected of them. When people have little knowledge of the requirements of a task, they are unable to judge whether they have the capabilities necessary for fulfilling the task.
>
> (Annek Vrugt & Zeeberg, 2002, p. 388)

Recruitment for the WCP places a strong emphasis on grade 9 and 10 students to allow for an extended exposure to the six pillars of the program during their high school career:

- CubeSat
- BCube
- Amateur Radio
- Manitoba Space Adventure Camp
- Ground Station
- ARISS Telebridge

The content may seem overwhelming and new students may question their self-efficacy in this realm. At the school that is being surveyed, there is a large immigrant population that may also impact the fact that they are not only new to the school, but new to Canada. How students are made aware of the WCP needs to be reviewed in order to make it a viable option for students in the study school.

2.4 Student Efficacy

Self-efficacy is important in understanding student motivation to join and remain with an extracurricular activity. It can be defined as a "personal judgment of one's capabilities to organize and execute a course of action to attain designated goals" (Zimmerman, 2000, p. 83). But "self-efficacy beliefs differ conceptually and psychometrically from closely related constructs, such as outcome expectations, self-concepts, and perceived control" (Zimmerman, 2000, p. 84). Self-concept "measures emphasize self-esteem reactions by posing self-evaluative questions" like 'how good are you in science?' while self-efficacy "focuses exclusively on task-specific performance expectations" like 'how certain are you that you can diagram this circuit' (Zimmerman, 2000, p. 84).

Students will select activities about which they feel most efficacious and which they have a high expectation for success (Eccles, 1994). Drawing from the similarity of student enrollment in optional courses at high school, students will enroll in courses where there is an expectation for success – a "sense of domain-specific personal efficacy" which depends on one's confidence in their intellectual abilities and estimated level of difficulty they will encounter (Eccles, 1994, p. 589). Cervone (2000) states that people "actively weigh the relation between their perceived skills and the demands of tasks when thinking about their capabilities for performance" (p. 32). There are four indices that have an affect on self-efficacy:

- **Enactive attainment**: based on personal experiences
- **Vicarious influences**: based on observer's self-comparison with outcomes achieved by another
- **Verbal persuasion**: outcomes are described and not directly observed
- **Physiological reaction**: relating to physical incapability such as fatigue, stress, and other emotions

(Zimmerman, 2000, p.88)

Of the four self-efficacy indices, the first three are addressed in this chapter. Enactive attainment and vicarious influences involving past experiences with a particular skill set will be dealt with in section 2.6.3 of this chapter. The issue of verbal persuasion plays a key role in WCP recruitment.

Although verbal persuasion has limited impact on student self-efficacy when compared to enactive attainment (Zimmerman, 2000), it is critical in WCP recruitment. As described in the introduction of this chapter, the WCP is often solely promoted by descriptors shared with students by teachers at a school. If student candidates are not receiving a clear picture of the WCP outcomes and program descriptions, they may not feel they posses the capabilities to affectively participate in the WCP. If we assume that someone has done an effective job in sharing their verbal persuasion of the WCP objectives to potential students, self-efficacy provides greater insight into student decision to join or not over other motivational constructs. That is because self-efficacy is more specific and closer to in correspondence to the performance task presented (Zimmerman, 2000).

Three components of self-efficacy define the "in the moment" decision whether or not to participate in an extracurricular activity:

- **Level of self-efficacy**: refers to its dependence on the difficulty of a particular task
- **Generality**: pertains to the transferability of self-efficacy beliefs across activities
- **Strength of perceived efficacy**: is measured by the amount of one's certainty about performing a given task

(Zimmerman, 2000, p. 83)

When presented with the opportunity to join an extracurricular activity such as the WCP, a student will assess the level of perceived difficulty, determine if they have what they believe it takes to accomplish the described outcomes and decide if they will join. Other motivational constructs will be presented in this chapter, but self-efficacy provides some insight into the decision to join the WCP.

> Unlike self-beliefs assumed to have trait-like stability across time and setting, self-efficacy is assumed to be responsive to changes in personal context and outcomes, whether experienced directly, vicariously, verbally, or physiologically. As a result of this sensitivity, self-efficacy beliefs are studied as indicators of change during instructional interventions as well as indicators of initial individual differences.
>
> (Zimmerman, 2000, p. 88)

Students that join an extra-curricular program and remain with it are self-efficacious and tend to "participate more readily, work harder, persist longer and have fewer adverse emotional reactions when they encounter difficulties then those who doubt their capabilities" (Zimmerman, 2000, p. 86).

2.5 Time

The influence of student time to participate in an extracurricular opportunity also impacts students' choice of activity (Eccles, 1994). The "potential cost of investing time in one activity rather than another" is one variable that impacts a persons achievement related choices (Eccles, 1994, p. 598). Given the five major activity categories identified in Section 2.2, the number of potential extracurricular choices is great. High school students participating in out of school science and math activities is low with most students opting to "hang out" with friends, working, or engaging in other extracurricular activities (Larson & Verona, 1999). Students that participate in extracurricular activities have been "linked to increases on indicators of positive development such as self-concept, high school grade point average (GPA), school engagement, and educational aspirations" (Eccles & Barber, 1999, p. 12).

Eccles and Templeton (2002) found that community-based programs offered during regular school hours had a better attendance than after-school programs:

> Many community based programs...are offered at school during the regular school hours, random assignments may be easier and more successful because the participants are more likely to attend regularly and complete the program. In contrast, the voluntary nature of joining and attending after-school community-based youth programs, particularly if they are situated in nonschool settings during non-school hours, leads to more sporadic attendance and higher rates of dropping out.
>
> (Eccles & Templeton, 2002, p. 118)

The majority of WCP activities take place during lunch, after school or on the weekend. It is often difficult to have WCP participants attend these sessions because of school, work and family commitments. The time WCP students commit to the program is often an issue.

2.6 Student Attitudes toward Science

In Section 2.4, self-efficacy was described as focusing "exclusively on task-specific performance expectations" (Zimmerman, 2000, p. 84). In the following sections there will be a review of influences on the self-concept of student attitudes toward science that reflect a students past experiences, present associations and future aspirations. These three factors can impact a student's decision to join an academic activity like the WCP.

Student attitudes with regards to science can be placed into "two broad subsets of science-related attitudes," the first being "scientific attitudes" and the second "attitudes to science" (Schibeci, 1983, p. 597). Scientific attitudes are considered to be attitudes that professional scientists display through their behavior in the workplace (Kozlow & Nay, 1976; Schibeci, 1983). Attitudes toward science, about which this project is concerned, relate to a student's attitude to science as a concept or field of study (Schibeci, 1983). Long-term effects of student attitudes have been shown to influence an individual's interest to carry out further study in secondary and post-secondary education (Simon, 2000; Simpson & Oliver, 1990). Simpson and Oliver (1990) found that students tracked from grades 6-10 showed a drop in positive attitude toward science between each consecutive school year.

> If adolescents enter middle or junior high school with positive feelings toward science, and experience success during their initial courses in science, it is likely that they will elect to take and will be successful in additional science courses. This, in turn, leads to a positive commitment to science that influences lifelong interest and learning in science. If, however, a youngster receives little support from home, is exposed to little or no science in elementary school, and does not have positive experiences in science during the initial courses in middle or junior high school, he or she will likely attempt to avoid science and by the end of high school and lack both knowledge in and commitment to science.
>
> (Simpson & Oliver, 1990, p. 14)

The specific areas that have shown to impact attitudes toward science include family, peers, student self-perception, relevance, interest, and gender. Family provides background information on parental support and stimulation for science education at home. Peers reflect the social impact classmates can have on a student's decision to join an extracurricular activity. Relevance is a measure of how an activity can meet an individual's short- and long-term goals. Interest looks at a whether a student has an interest in the subject and considers it to be important. Gender is a reflection of intrinsic student interest based on whether they are female or male.

2.6.1 Family

Family behaviors toward school have a great impact on student attitudes (Tocci & Englehard, 1991; Talton & Simpson, 1986), specifically to science (Simpson & Oliver, 1990). Simpson and Oliver (1990) found that a student's family attitude toward science becomes more negative than positive as a student moves from grades 7 to 10. This corresponds to a decrease in positive student attitudes toward science from grades 6 to 10 (Simpson & Oliver, 1990). Yet those parents that support participation in extracurricular activities "can play an important role in the child's affective experience" (Anderson et al., 2003, p. 253). In the home, parental and sibling influences can include visiting science centers, reading science materials or watching science television shows, and even helping with a child's science homework.

> Parents and siblings are important to children. Their action, such as watching science programs on television, going to museums, visiting zoos, or taking trips to the ocean or mountains, are models for a child's actions.
>
> (Simpson & Troost, 1982, p. 767)

Other parental influences can include "the number of science books and materials available in the home, parental support for homework, and the more general pattern of leisure activity" (Simpson & Troost, 1982, p. 767). The influences the student can experience from their home life can affect their "self-esteem, locus of control and can be expected to influence commitment to a subject" (Simpson & Troost, 1982, p. 767).

If there is a strong display and support for fostering positive attitudes toward science, perhaps students may be more inclined to study science concepts. There has been some relationship shown between parental education attainment and student's choice of science coursework:

> Parent education significantly predicted girls' 5^{th}-grade science grades and activity participation but not the number of physical science courses they took throughout high school. The opposite associations emerged for boys. These relations suggest that parent education has an early impact on girls' science choices and performance, but later impact boys.
>
> (Simpkins, Davis-Kean & Eccles, 2006, p. 81)

A possible explanation of the difference between boys and girls influenced by their parent's education may be a reflection of gender roles:

> The gender differences between parent education and number of physical science courses may result from differential expectations. The influence of parent education may be small above the impact of girls' self-concept. In other words, parents may allow girls more freedom in their course choices. On the other hand, boys whose parents are more educated may expect their sons to take physical science courses regardless of boy's self-concepts.
>
> (Simpkins, Davis-Kean & Eccles, 2006, p. 81)

The one area of study will be to look for general correlations between parental education and student interest in the field of science. Specific gender issues relating to course selections and extracurricular interests will be presented in Section

Although this thesis is not evaluating the socioeconomic status (SES) of the participating students, family income can have an impact on exposure to enrichment activities (Simpkins, Davis-Kean, & Eccles, 2006; Anderson et al., 2003). For example, middle-class incomes "may have more resources to devote to children's participation in organized activities and creating an enriching home environment then families of other socioeconomic status (SES) backgrounds" (Simpkins, Davis-Kean & Eccles, 2006, p. 81). Students from lower SES may not have the same opportunities:

> ...children in lower SES families are likely to get less exposure to early math and science skills. In addition, low-income families' efforts may need to be devoted to children's basic needs (e.g., providing food and safety) rather then supporting

> or promoting youth's pursuit of math and science because of other life circumstances (e.g., working two jobs, overriding concern about their child's safety in a high-crime neighborhood). Little math and science support in the home may make children less likely to be exposed to early math and science activities, values, and role models, and as a result, less likely to pursue math- and science-enriched pathways.
>
> (Simpkins, Davis-Kean & Eccles, 2006, p. 81)

Students' exposure to enriching science experiences will be evaluated in the questionnaire component of this project. But reasons why or why they don't occur because of economic reasons will not be addressed. Instead a search for a relationship between enrichment experience and attitudes toward science will be evaluated.

Parents may play a more direct role in student participation in extracurricular activities:

> Adolescents with parents who place a stronger emphasis on educational achievement then on activity participation may limit the activities in which these adolescents take part. Some adolescents may be able to participate only in academic clubs that might improve their chances of attending college, and some may not be able to participate at all as a result of the time it might take away from school work. Alternatively, high achieving adolescents, or those who are highly focused on academics, may have parents who encourage them to explore activities outside of schoolwork. In addition, adolescent's friends, teachers, and the available resources of the school and the state may influence their opportunities to participate in activities and their experiences of such participation.
>
> (Feldman & Matjasko, 2005, p. 196)

This project acknowledges the point Feldman and Matjasko make in regards to forbidding or forcing a student to participate in an activity by parents, but it will not be addressed in the questionnaire used. Rather the exposure to science a student experiences at home will be explored.

2.6.2 Peers

Peers have a strong influence on an individual's attitude toward science. Studies have found that students who participated in any of the five extracurricular activities described in Section 2.2 have more academic and prosocial friends than non-participants (Fredricks & Eccles, 2005; Eccles & Barber, 1999). This section will first review the influences friends may have on an individual's choice to join an extracurricular science activity like the WCP. The second part will review the development and influences peers have on a student within activity.

2.6.2.1 Peer Influence on Joining Extracurricular Activities

Eccles and Barber (1999) note that there is a positive relationship between a student joining an activity with academic outcomes and their peer groups present academic standing and post-secondary plans. Students who participate in an academic activity have a peer group that is "characterized by a higher proportion of friends who plan on attending college and are doing well in school (with the exception of sport participants)" (Eccles & Barber, 1999, p. 31).

The influence of peers on evaluating student attitudes may be difficult because of the social nature of school. At home, displayed student attitude around one's parents may be significantly different than those demonstrated in a classroom.

> … a pupil may express interest in science but avoid publicly demonstrating it among his or her peers, who regard such an expression of intellectual interest as not being the 'done' thing. In such a case, motivation to behave in a particular way may be stronger than the motivation associated with the expressed attitude, or alternatively, anticipated consequences of a behavior may modify that behavior so that it's inconsistent with the attitude held.
>
> (Simon, 2000, p. 106)

At the school that is being surveyed, the WCP is offered as an extracurricular activity. It is hoped that this investigation will provide some insight into peer influence on initial interest in the WCP. Do students join despite their peer non-interests, or do students not join because it is not the 'in thing to do' based on peer ideals?

By including an evaluation of a student's evaluation of their peers' attitude toward science, an insight into the possible reason students join and remain a part of the WCP. Simpson and Troost (1982) stated that "best friends and significant others who like or dislike science may be strong influences on students' attitudes toward science" (p. 769). The behaviors and goals of a student's peers is one influence on educational choices. (Updegraff et al, 1996, p. 241).

> …peers may positively reinforce conventional behaviors, may exert pressure toward school involvement, and may model positive affect and commitment to academic endeavours.
>
> (Fredricks & Eccles, 2005, p. 517)

If this is true, perhaps the experience of students who participate in the WCP without a number of their friends who do not hold a positive view of science may be able to develop a positive attitude themselves. The result could be a positive influence on the friends of students who participate in the WCP. Within the WCP group, participation may "allow students to learn from each other and thereby take advantage of the normal social and gregarious tendencies of adolescent students" (Simpson & Troost, 1982, p. 769).

2.6.2.2 Peer Group Development within the WinCube Project

For those students who join extracurricular activities, a new peer group can develop within such an activity that will have common interests and attitudes. The activity will provide a "peer group as well as a set of tasks" (Eccles & Barber, 1999, p. 31).

> Many of the activities students study take up a considerable amount of the adolescents' time and are done with other adolescents and adults. Thus, it is likely that participation in some of these activities directly affects adolescents' peer groups precisely because such participation structures a substantial amount of peer group interaction. One's co participants become's one's peer crowd, and

> such peer crowds often develop an activity based culture, providing adolescents with the opportunity to identify with a group having a shared sense of style.
> (Eccles & Barber, 1999, p. 29)

The development of a new peer group dynamic within an extracurricular activity can in turn provide a positive or negative influence on participation:

> To the extent that one spends a lot of time in these activity settings with the other participants, it is likely that one's friends will be drawn from among the other participants. It is also likely that the collective behaviors of the peer group will influence the behaviors of each member.
> (Eccles & Barber, 1999, p. 31)

The collective behavior that develops within the activity can either support a student's attitude toward science, or the student can reject the group identity.

> Activity choice is likely to both grow out of and reinforce emerging identities – particularly those aspects of identity linked to instructional success and finding one's place in the social milieu. Activity choice also channels friendship networks due to propinquity and to shared interests. Friendship networks further reinforce the value of various types of activities and identities. Friendship networks also develop cultures of their own, which set the norms for a wide range of behaviors and long-term expectations and aspirations, thus influencing behaviors across several domains.
> (Eccles & Barber, 1999, p. 31)

Extracurricular activities provide an opportunity "to get to know other peers and adults through personal bonding and mutual trust and commitment" (Feldman & Matjasko, 2005, p. 162). The individual interview in this research project will hopefully shed some light on the interactions of students who have participated in the WCP. This may prove to be a key area of why students remain in the WCP.

2.6.3 Student Self-Perception

There is a distinction between a student's personal self-efficacy and their self-concept. Self-concept measures and emphasizes "self-esteem reactions by posing self-evaluative questions" like 'how good am I in science?' while self-efficacy "focuses exclusively on task-specific performance expectations" such as 'how certain are am I that I can diagram this circuit' (Zimmerman, 2000, p. 84). In the following subsections of attitudes toward science, family, peers, self-perception, relevance and student interest will be categorized as self-concepts. Self-efficacy does focus on a student's more immediate judgment about joining the WCP. Self-concept will be surveyed in the questionnaire and will provide some insight into student influences in joining an academic activity like the WCP.

Self-perception is an evaluation by a student of their abilities to accomplish a task. Talton and Simpson (1986) found "that with a strong positive regard for their own abilities to learn have a more positive attitude toward science" (p. 365). These students who posses a positive attitude toward science might be more inclined to join an academic activity such as the WCP. On the other hand, some students who hear about the WCP may not be interested in joining because of a perceived fatalism. Student fatalism is "the tendency for students to feel that they have little control over their success, or lack of it, in school" (Haladyna, Olsen & Shaughnessy, 1983, p. 323). Haladyna, Olsen, and Shaughnessy (1983) found that student fatalism becomes very influential in grades 7 and 9, a time in a student's academic career where they begin to make decisions about taking science courses in high school.

> Indeed, it seems entirely reasonable to suggest that fatalism is closely related to self-esteem construct which has been thoroughly examined by affective researchers and has been linked to methods of attitude development and change. If schools promote defeatism and failure in students, then fatalism will increase, culminating in termination of formal education and continuing negative attitudes toward the institution of school and its subject matters where failure was most evident.
>
> (Haladyna, Olsen & Shaughnessy, 1983, p. 323)

It is evident from this statement that student success within a science classroom influences further interest in studying science including extracurricular academic activities. If students are not engaged in active learning and they do not experience some success, they will be turned off from the subject area and as a result will not develop positive attitudes toward science.

A student's level of success within a science classroom will influence their interest in a subject and in turn will help determine if a student will continue to study science later in life.

> …attitude and motivation toward science when combined with achievement in initial required science courses produces a self-concept in science that serves as an important influence during the high school years.
>
> (Simpson and Oliver, 1990, p. 14)

Simpson and Oliver (1990) found a correlation between a decline in achievement motivation and attitudes toward science. It was shown that between grades 6-10, motivation dropped within each year and between grade levels (Simpson & Oliver, 1990).

> Student perceptions on the value of learning science may be considered as both an input and outcome variable because science attitudes can be related to educational achievement in ways that reinforce higher or lower performance. That is, students who do well in science generally have more positive attitudes toward science subjects and those who have more positive attitudes tend to perform better.
>
> (Beaton et. al., 1996 as cited in Papanastasiou, 2002, p. 72)

It is clear that student self-perception and achievement in a science class in lower grade levels will influence whether a student continues to study science in grade 11 and 12 or after graduation from high school. In Manitoba, science becomes optional after grade 10. If students continue to take optional science courses in grade 11 and 12, this may indicate they have a positive self-concept and attitude toward science in the specific field they register for (Physics, Chemistry, or Biology). It can also apply to a student's willingness to join an academic activity such as the WCP.

For those students in an academic activity, a student's self-perception in that field of study can be positively or negatively affected. Extracurricular activities can "offer a place to develop additional skills and recognition that extend beyond academic achievement" (Feldman & Matjasko, 2005, p. 162). If the learning environment is conducive for student learning and student success, then "by increasing positive feelings toward a specific discipline the discipline related self-concept will improve" (Talton & Simpson, 1986, p. 365). In a review of articles, Feldman and Matjasko (2005) found that the "majority of the findings revealed a positive relation between most extracurricular activities and self-esteem among boys and between specific activities and self-esteem among girls" (p. 187).

2.6.4 Relevance

Relevance as it relates to a student participating in an activity can include relevance to everyday events or existing ideas (Schollum & Osborne, 1985) and is "instrumental in meeting one of the individual's long- or short-term goals" (Eccles, 1994, p. 589). It can also include the following:

> ...personal needs, self-images, and values operate in ways that both decrease the probability of engaging in those activities or roles perceived as inconsistent with one's central values and increase the probability of engaging in roles or activities perceived as consistent with one's definition of self... individuals can be related to their needs and values.
>
> (Eccles, 1994, p. 597)

Students surveyed by Schollum and Osborne (1985) found that university students indicated they lost their enthusiasm for science during high school because of "what they perceived as a lack of relevance, of what they were asked to do, to their everyday lives"

(p. 12). WCP students are provided background with knowledge and skills that are applied to the activities in the WCP. What WCP students learn, they apply to their everyday lives. However, potential student candidates may see the WCP academic activity as irrelevant because of their past science experiences and decide not to join.

If students have participated in WCP activities, relevance to everyday experiences can become a factor to remain with the project. Yager (2004b) points out that "there is often a discrepancy between school science and real-world experiences. Real-world experiences with science are remembered more than experiences with the science of textbooks in classrooms and laboratories" (Yager, 2004b, p. 413). The WCP emphasizes real-world experiences with its multi-activity approach to education which provides motivation for continued participation.

> The importance of context in science teaching finally has become apparent. In fact, the context for learning now is advanced as being more important in promoting learning than are the concepts and the process skills per se. These science concepts and process skills continue to be seen as important outcomes for science teaching, but neither helps achieve real understanding unless there is a real-world situation (context) for seeing, learning, and using ideas and skills that often are portrayed as central to school science. Teaching science concepts and process skills without context ignores the very essence of science. Establishing an appropriate and relevant context for learning science is necessary for the understanding of basic science concepts and process skills.
>
> (Yager, 2004a, pp. 101-102)

The WCP provided numerous hands on opportunities for students to apply what they have learned. This approach allows a context to be established where the six pillars of conceptual knowledge and process skills can meet specific curricular objectives. Relevance of science concepts and procedures is necessary in education to engage students in learning. If students are unable to see how what their learning affects their lives, they may not develop a positive attitude toward the topic.

2.6.5 Student Interest

Students who enroll in elective math and science course show a strong association between their own interest and belief that these subjects are important (Simpkinns, Davis-Kean & Eccles, 2006). In Manitoba, math courses are mandatory through to grade 12. Science courses become optional after grade 10. Those students who take optional science classes may display a strong interest in the particular optional science course they register for in grades 11 and 12 (Physics, Chemistry, Biology). Simpkins, Davis-Kean and Eccles (2006) found that students "who earn good grades in math and science are more likely to participate in after-school activities and continue with coursework in these areas" (p. 80)

For those students who have participated in extra-curricular activities, they "report feeling both more challenged and enjoyment (as opposed to boredom) in organized out-of-school activity settings then in classrooms" (Eccles & Templeton, 2002, p. 123).

Developing student interest in science requires acknowledgement of two conflicting goals in science education; cognitive development of students to acquire scientific investigative skills, and creating an educational environment that appeals to a student's interest. Further, "while scientists search for regularities in nature, for ways to predict events and to reduce the likelihood of the unexpected, children are frequently interested in the exact opposite, in that they wish to discover the irregular, the unpredictable and the surprise (Schollum & Osborne, 1987, p. 56). Discovering the "irregular, the unpredictable and the surprise" (Schollum & Osborne, 1987, p. 56) implies a sense of curiosity amongst students. A curiosity that Simon (2001) sees as a motivational factor in the classroom.

> … it is not enough that they {students} believe that science is practically important. They must also be curious. Curiosity calls attention to interesting, odd, and sometimes important items in the drama that is revealed to us through our senses. Idle or purposeful, curiosity is the motor that interests children in science, it is also the principal motor that energizes and steers the education at professional scientists and the conduct of their subsequent scientific work.
> (Simon, 2001, p. 5)

Aerospace education can be an intriguing and ever evolving subject in science. Students are bombarded with images from the media and movies relating to aerospace topics. The possible sources for aerospace education are endless, but educators must keep in mind that "our attention can be sustained as long as we can continue to find interesting patterns in the stimulus" (Simon, 2001, p. 6). Providing a challenging learning experience will require a level of complexity that depends on a student's prior knowledge (Simon, 2001).

> … a reasonably rich environment, but one that does not continually force new stimuli on children instead of leaving the initiative to them in seeking pattern, is most conducive to encouraging active curiosity.
> (Simon, 2001, p. 7).

In providing an interesting environment for learning, it becomes important to allow students to explore on their own once a student becomes interested in the topic. With the WCP, students seem keen on working towards their involvement with a CubeSat mission. The process itself will be one of exploration.

2.6.6 Gender Difference

There have been numerous studies involving gender and attitudes toward science. Miller et al. (2006) found that in general, males have a greater interest in science than females. Other studies have shown the opposite, that females are more interested in science topics than males (Matthews, 2007). Regarding course selection for specific science subjects, females preferred biology over physics and males physics over biology

(Baram-Tsabari & Yarden, 2008; Farenga & Joyce, 1999; Jones et al., 2000). The implications of these findings is the WCP is based on physics as opposed to a biology. From the research cited here there should be a greater percentage of males interested in an aerospace program than females.

Reid and Skryabina (2003) have developed a theory explaining the female preference for biology and male preference for physics. They propose that females are more inclined to take studies that have a high social relevance and males a high mechanical or practical relevance. The WCP work is primarily hands on with the application of technology in payload mission.

Goal three of the WCP, *enrichment for students to develop further interest in science and engineering,* addresses gender differences by increasing both genders' exposure to career options. Research has found that males tend to demonstrate particular positive attitudes toward careers in science than females (Crettaz van Roten, 2004; Miller et al., 2006). The implication of this observation is females may be reluctant to join the WCP if future educational goals or science careers are not in the field of aerospace.

2.7 Summary

In this chapter I have provided an overview of the literature describing the role extracurricular activities play in the educational experience and self-efficacy issues that can impact a student joining such activities. Also presented were contributing factors that effect student participation in extracurricular activities like time, student attitudes toward science, family, peers, student self-perception, relevance and interests, and gender. In the next chapter, methodology used in the research in this project will be described.

Chapter 3: Methodology

3.1 Introduction

This research project is attempting to evaluate student interest in a voluntary extracurricular aerospace program. Specifically to determine the effectiveness of the practices used for attracting and retaining Manitoba high school students in the WinCube Project (WCP). The theses will also examine the influence of the WCP on participant's career and recreational choices.

Previous studies on extracurricular activities have focused on the number of students participating in a specific activity (Gadbois and Bowker, 2007; Fredricks and Eccles, 2005; Annek Vrugt and Zeeberg, 2002; Eccles and Templeton, 2002; Eccles and Barber, 1999; Eccles, 1994; Agnew and Peterson, 1989). Also the affect participation has had on student delinquency (Eccles & Tempelton, 2002; Eccles & Barber, 1999; Agnew & Peterson, 1989), drug/alcohol abuse (Fredricks & Eccles, 2005; Eccles & Barber, 1999), and academic achievement (Anneke Vrugt & Zeeberg, 2002; Cervone, 2000; Eccles & Barber, 1999).

Other studies have looked at the influences of student participation in an extracurricular activity or choice of optional science courses. Influences such as self-efficacy (Cervone, 2000; Zimmerman, 2000; Updegraff et al., 1996; Eccles, 1994), family (Simpkins, Davis-Kean and Eccles, 2006; Anderson et al., 2003; Tocci and Englehard, 1991; Talton and Oliver, 1990; Simpson and Oliver, 1990; Simpson and Troost, 1982), peers (Fredricks and Eccles, 2005; Simon, 2000; Eccles and Barber, 1999; Updegraff et al., 1996; Simpson and Troost, 1982), self-perception (Simpson and Oliver, 1990; Talton and Simpson, 1986; Haladyna, Olsen and Shaughnessy, 1983), interest and relevance (Simpkins, Davis- Kean and Eccles, 2006; Yager, 2004a, 2004b; Eccles and Templeton, 2002; Simon, 2001; Eccles, 1994; Schollum and Osborne, 1985).

Previous aspects that have been shown to impact student participation have included the influence of family and peers, a student's self-efficacy, student self-concept, student interest, relevance, and gender. Other studies identified in the previous chapter have focused on these variables and investigated their impact on numerous outcomes of extracurricular activities. In the review of articles relating to the role of school-based extracurricular activities in adolescent development, Feldman and Matjasko (2005) make a number of suggestions for a further look in the field that applies to this project. One suggestion calls for creating different measures for describing activity involvement. Typical studies that use simple descriptors like gender, race, and socioeconomic status (SES) need to be further developed to include the "characteristics of participants "including individual, family, peer, school, and neighborhood contexts" (Feldman & Matjasko, 2005, p. 194). This research project will look for a correlation between influences acting on a student (e.g. Family, peers, self-concept, interest, relevance, and gender) to participation in an extracurricular aerospace activity (the WCP).

The second point to draw from Feldman and Matjasko's (2005) recommendations is to move from a generalized categorization of an activity to a more focused evaluation. Feldman and Matjesko (2005) provide a sport example that demonstrates this need:

> Regarding identification of the effects of individual activities, in many cases "sports" has been as a blanket term used to capture individuals who are involved in athletics. Key research has shown that the effects of sport participation should be "unpacked," and the effects of specific sports, such as soccer and lacrosse, should be considered. Although it may require large sample sizes or the creation of alternative sampling strategies, such a distinction might lead to more clear-cut results regarding the potential benefits of participating in a specific activity. (p. 194)

In Chapter Two, the WCP was identified under the general category of an academic club (Eccles & Barber, 1999). Following Feldman and Matjasko's recommendation, this study will look at the WCP as a specific extracurricular activity, rather than a general academic club.

3.2 Questions

The four research questions addressed in this study are:

1. What factors influence student initial participation in the WCP?

2. What factors influence student ongoing participation in the WCP?

3. What influences does student participation in the WCP on future career aspirations?

4. To what degree do participants of the WCP believe the fundamental goals of the WCP have been achieved?

A detailed explanation of the specific questions can be found in section 1.7 of this work.

The research questions can be placed under three general headings:

- What influences student choice to participate in the WCP?
- Why do students choose to remain with the WCP?
- What are the influences of the program on those that participate?

In order to answer these questions, a case study will be carried out using a general questionnaire and an individual interview. Case studies are an "empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and the context are not too clearly defined" (Yin, 1994, p. 13). The questionnaire will be administered to all participants in this research study group to garner data on student demographics, and possible influences in choosing to participate in the extracurricular activity, the WCP. The rationale for using a case study for the interview portion of this investigation is that it "follows the research philosophy of analyzing an existing, real life situation in all its complexity, exploring it as close to the people concerned as possible, describing the situation in as much detail as possible, and finally explaining the findings is a clear and comprehensible way" (Kyburz-Graber, 2004, p. 54). The students who participated in the WCP and completed the individual interviews will be analyzed in a case study format to look at their perceptions and experiences with the WCP.

The exploratory-causal case study "tries to interpret phenomena to the point of answering questions of 'why' on a theoretical basis" (Kyburz-Graber, 2004, p. 54). In the case of the WCP as an extracurricular activity, the variables to join and remain involved can be vast as demonstrated in Chapter 2 of this work. The case studies approach is appropriate in this investigation given that its methodology is employed when the "contextual conditions are an important aspect of the phenomenon of interest" (Stevenson, 2004, p. 41). The individual interview results will be paired up with the completed questionnaires to try to gain some insight into WCP participation.

The exploratory-causal case study includes five key areas (Kyburz-Graber, 2004):

1. Theoretical basis and case study protocol
   - Includes theoretical basis and research questions
2. Multiple data sources in methods and procedures
   - Allows the use of multiple perspectives to be interpreted
3. Documentation of case-study research and report
   - All data collected and the treatment of the data is to be made available
4. Designing a chain of evidence
   - A clear line of logical presentation of evidence derived from data interpolation
5. Logic of generalization

The first key area of theoretical basis and protocol has been presented in the first two chapters of this work. The second area of multiple sources includes the questionnaire and individual interview of students who have participated in the WCP. The documentation of research and report includes copies of student responses to the questionnaire (Appendix D) and the paraphrased responses to the interview for each participant in Chapter Five. The evidential case for key area four will be presented in Chapter 4 and Chapter 5. Generalization of this project will also be developed in Chapters 6.

3.3 Participants

The school that this research project took place is an urban high school located in Winnipeg, Manitoba, Canada. The student population at the school is approximately 1200 students with a diverse ethnic mix with the majority of European descent, Philippino, East Indian, and Aboriginal.

There were two evaluative tools used in this project: a questionnaire and a personal interview. For the questionnaire, the primary participants were drawn from two grade 10 Geography classes at the school, one from the first semester and the other from the second semester. The Geography teacher had informed both classes on numerous occasion about the existence of the WCP within the school. He encouraged his first semester class to join in a BCube launch from the school and encouraged second semester students to participate in a BCube launch slated for the summer of 2009. The second semester class was also encouraged to participate in the WCP's Manitoba Space Adventure Camp (MSAC) held at the University of Manitoba's Faculty of Engineering in July, 2009.

The research questionnaire was administered at the end of the second semester to the latter Geography class. Those students who had taken Geography in the first semester, their timetables were consulted and second semester grade 10 morning core subject classes were identified that had at least three students who were in the original first semester grade 10 Geography class. In total there were six classes that participated in the survey: one English, one Consumer Math, three Science, and one Geography (all at the grade 10 level).

A total of 56 females and 44 males participated in the questionnaire component exclusively. Average age for the females was 15.6 years old and for the males, average age was 16.6. The overall grade level for both groups was grade 10 (95% of females, 95% of males.)

These six classes were singled out from all of the other classes in the school because a number of students in each class had heard about the WCP from their Geography teacher at some point during the year. For the remainder of the participants in these six classes, it is assumed they would have heard about the WCP from their Teacher Advisors using program information and announcements made available by the researcher throughout the school year. There was also a small group of students who were not in the six class sampling but participated in the WCP activities and were also asked to complete the questionnaire. The specifics of the questionnaire will be presented in Section 3.4 of this chapter.

Students who participated in the WCP activities, were asked to participate in a follow up individual interview. The interview was carried out by an independent neutral third party, with answers documented using hand written notes by the interviewer. Those results are presented and discussed in Chapter Five. Participation in the questionnaire and individual interview were voluntary. A form was issued that required parental and student consent for participation.

3.4 Student Questionnaire

The questionnaire was administered to all students who participated in this study. Questions were categorized into eight main groups:

1. Demographics
2. Present education
3. Future Education
4. Family
5. Peers
6. Extracurricular activities
7. Interest and relevance
8. WinCube Project participation

In the following sections of this chapter, description of the questions and techniques used in the questionnaire will be presented. A copy of the questionnaire can be found in appendix C.

3.4.1 Demographics

Questions (1 to 3) with fixed-choice answers gathered background information about the participants (sex, age, grade presently enrolled in). The questions about grade presently enrolled in takes into account students from other grade levels presently taking a grade 10 class.

3.4.2 Present Education

Current level of education was asked using fixed-choices (Table 3.1) based on science and math courses available at the targeted school using question 4. Computer science was included as a reflection of computer programming opportunities in the

WCP's BCube and CubeSat portions of the project. The answers will provide data on student interest in these fields of study. Questions 28 and 29 used Likert-scales to determine student perception of space education they have experienced.

Table: 3.1 Present Education

Q. 4. Please indicate which science and math courses you have ***completed*** at school (Check all that apply):			
a.	___ Grade 9 Math	j.	___ Grade 11 Biology
b.	___ Grade 10 Consumer Math	k.	___ Grade 12 Biology
c.	___ Grade 11 Consumer Math	l.	___ Grade 11 Chemistry
d.	___ Grade 12 Consumer Math	m.	___ Grade 12 Chemistry
e.	___ Grade 10 Pre-Cal Math	n.	___ Grade 11 Physics
f.	___ Grade 11 Pre-Cal Math	o.	___ Grade 12 Physics
g.	___ Grade 12 Pre-Cal Math	p.	___ Grade 11 Computer Science
h.	___ Grade 9 Science	q.	___ Grade 12 Computer Science
i.	___ Grade 10 Science		
Q. 28. How much importance do you feel has been given to space and space-related topics, in the context of your early and middle school education?			
___ A lot	___ Some	___ A little	___ Nothing
Q. 29. How much importance do you feel has been given to space and space-related topics, in the context of your high-school education?			
___ A lot	___ Some	___ A little	___ Nothing

3.4.3 Future Education

In order to develop an understanding of a student's attitude toward science, a series of questions were asked (Table 3.2) about future plans in regards to science education. This included immediate plans for future courses to be taken at the targeted high school using fixed-choice answers (Table 3.2, Question 5). Post-graduation plans were asked with both fixed-choices (Table 3.2, Question 8, 10) and open-ended responses (Table 3.2, Question 10). Question 10 targeted coursework that reflect an interest in science and math as well as specific areas related to the WCP (computer science and engineering). Other open-ended questions surveyed occupational choices after high school graduation for those either going onto a post-secondary institution or those directly entering the work force (Table 3.2, Q. 11 and Q. 12).

Table 3.2: Future Education

5. Please indicate which science and math courses you ***plan to take*** at school in the future (Check all that apply): a. ___ Grade 9 Math b. ___ Grade 10 Consumer Math c. ___ Grade 11 Consumer Math d. ___ Grade 12 Consumer Math e. ___ Grade 10 Pre-Cal Math f. ___ Grade 11 Pre-Cal Math g. ___ Grade 12 Pre-Cal Math h. ___ Grade 9 Science i. ___ Grade 10 Science j. ___ Grade 11 Biology k. ___ Grade 12 Biology l. ___ Grade 11 Chemistry m. ___ Grade 12 Chemistry n. ___ Grade 11 Physics o. ___ Grade 12 Physics p. ___ Grade 11 Computer Science q. ___ Grade 12 Computer Science
Q. 8. When I graduate from high school, I plan to: a. ___ Go straight to work (please proceed to question 12) b. ___ Go to College c. ___ Go to University
Q. 9. Please state the field of study you plan to enter at University/College:
Q. 10. When you go to University/College, do you intend to take any courses in the following disciplines (please check all that apply)? a. ___ Physics b. ___ Computer Science c. ___ Engineering d. ___ Astronomy e. ___ Math f. ___ Biology g. ___ Chemistry
Q. 11. Please indicate the career you would like to do after graduating from University/College:
Q. 12. Please state the occupation you plan to work at after graduating from high school:

3.4.4 Family

Family has been shown to have an impact on student attitudes toward science (Simpkins, Davis-Kean, & Eccles, 2006; Anderson et al., 2003; Tocci & Englehard, 1991; Simpson & Oliver, 1990; Talton & Simpson, 1986; Simpson & Troost, 1982). The questions used for this area of research are found in Table 3.3. Question 15 provides information on parental or sibling influence on student attitudes toward science based on university or college level attained. Other studies have incorporated the mother's education as a measure of social economic status (Brown & Evans, 2002; Eccles & Barber, 1999). Questions 17, 19, 21, and 24 use Likert-scale response measurements to gauge the level of science related activity a student engages in either through television, the printed press, the internet, and movies. Similar yes/no questions were asked about family members demonstrating the same behaviors (Questions 18, 20, 22). Question 16 provides some insight into support at home for science education by asking if a student receives help with their science homework. Question 23 addresses the opportunities students could experience with their families that would help develop a positive attitude toward science through family outings to science related destinations. All questions in Table 3.3 contained opportunities for open-ended responses for students to elaborate on their answers.

Table 3.3: Family

15. The following family members have a university or college degree (please identify the field of study): a. ___ Mother (field of study: ______________) b. ___ Father (field of study: ______________) c. ___ Sister (field of study: ______________) d. ___ Sister (field of study: ______________) e. ___ Brother (field of study: ______________) f. ___ Brother (field of study: ______________)
16. Do you get help with your science homework at home? a. ___ No b. ___ Yes If Yes, from whom?

Table 3.3: Family (Continued)

17. How often do you watch scientific television programs or documentaries related to space topics? Always ___ Frequently ___ Seldom ___ Never ___ If you do watch space related shows, which ones? If never, why not?
18. Does anyone else at home watch scientific television programs or documentaries related to space topics? a. ___ No b. ___ Yes If yes, who and what shows?
19. How often do you read a scientific article related to space in the printed press (ex. Newspaper, magazine)? Always ___ Frequently ___ Seldom ___ Never ___ If you do read space related topics, which sources do you read? If never, why not?
20. Does anyone in your home read scientific articles related to space in the printed press (ex. Newspaper, magazine)? a. ___ No b. ___ Yes If yes, who and what are the sources?
21. How often do you surf Internet sites related to space topics? Always ___ Frequently ___ Seldom ___ Never ___ If never, why not?
22. Does anyone in your home surf Internet sites related to space topics? a. ___ No b. ___ Yes If yes, who and what are the sources?
23. Do you do science related activities outside your home with your family? (ex. Planetarium, science museum) c. ___ No d. ___ Yes If yes, what have you visited?
24. How often do you go to the theatre to watch science fiction movies about space and space related topics? ___ Always ___ Frequently ___ Seldom ___ Never If never, why not?

3.4.5 Peers

Question 25 (What three courses are your closest friend's most favorite subjects in high school?) and 26 (What three courses are your closest friend's least favorite subjects in high school?) are open-ended questions that attempt to indicate what subjects a subject's peers are interested in. Some researchers feel that "using perceived reports of peer behavior inflates relations between peer's and respondent's behavior" (Fredricks & Eccles, 2005, p. 517). Yet Fredricks and Eccles find this to be a "valid methodological critique" (p. 517). They believe that "the use of perceived reports of peer behavior is justified" because they believe that "what adolescents think about their friends is more important than what peers actually do" (Fredricks & Eccles, 2005, p. 517). Following Fredricks and Eccles' idea, this study will try to establish a link between peer subject preference and the influences and associations it can have for students participating in this survey.

3.4.6 Extracurricular activities

Question 13 (Please indicate all activities that you are involved with at school (ex. Volleyball, basketball, drama productions, Unity Group)) and question 14 (Please indicate all activities that you are involved with outside of school (ex. Dance group, volunteering)) are open-ended questions. These questions were used to determine the level of student extra-curricular activity involvement at the targeted school, and what activities are the most popular at the school. Some studies (Eccles & Barber, 1999) have used similar questions with fixed-responses, but this study chose to use open-ended responses because of the breadth of opportunities students have at the school and in the community.

3.4.7 Interest and Relevance

In order to gauge student interest in science, three open-ended questions were asked (Table : 3.4). The intention of question 6 and 7 is to determine the general interest in subjects offered at the participating school. This may provide insight into why such a small part of the student population at the targeted school becomes involved in the WCP. There will also be an analysis between student subject interests and student potential involvement in the WCP. A comparison will be made relating to favorite subjects and optional high school course selection and post-secondary decisions.

Question 27 will attempt to ascertain student interest in space endeavours and be compared to the educational goals and offerings of the WCP.

Table 3.4: Interest and Relevance

Q. 6. What are your three most favorite subjects in high school?
Q. 7. What are your three least favorite subjects in high school?
Q. 27. List your three favorite topics relating to space:

3.4.8 WinCube Project Participation

Question 30 (Have you ever heard of the WinCube Project?) and question 31 (Have you ever participated in the WinCube Project?) will allow for grouping of respondents using simple yes/no answers. Question 30 will provide insight first of all into the effectiveness of present promotion of the WCP (nearly all of the students should have heard of the WCP). Secondly, the questionnaire is set up to explain in some detail the offerings of the WCP. Subsequent follow up questions will be able to gauge student interest. Question 31 will identify students for the follow up individual interview.

For those students who have not heard about the WCP, a brief explanation of five of the six educational offerings of the program are presented: CubeSat (picosatellite), BCube (high altitude balloon payloads), Amateur Radio Course, Satellite Ground Station

(WinGS), and Manitoba Space Adventure Camp (MSAC). After each description, students were asked the following typical question:

> Based on the description of the Amateur Radio Course (ARC), would you ever consider joining this component of the WinCube Project?
> a. ___No
> b. ___ Yes
> Why or why not? Please explain your answer.

The same students who had not heard about the WCP were asked if they found the overall project appealing with a yes/no response followed by 'why or why not? Please explain your answer.' The students were then asked what activities sounded interesting (Table 3.5: Question 38).

Table 3.5: WinCube Project Participation

38. What activities in the WinCube Project sound interesting (check all that apply)? a. ___ CubeSat (picosatellite) b. ___ BCube (high altitude balloon) c. ___ Amateur Radio Class d. ___ Manitoba Space Adventure Camp e. ___ Satellite Ground Station f. ___ Introductory Aerospace Design Course g. ___ Industry tours h. ___ Working with Universities
39. Please indicate what activities you have participated in regards to the WinCube Project: (Check all that apply) a.___ CubeSat (picosatellite) a.___ BCube launch –Fall 2008 b.___ BCube launch - University of North Dakota Spring 2007 c.___ Amateur Radio Certification – 2006-2007 d.___ Amateur Radio Certification – 2007-2008 e.___ Manitoba Space Adventure Camp 2006 f. ___ Manitoba Space Adventure Camp 2007 g.___ Satellite Ground Station h.___ Introductory Aerospace Design Course – 2007-2008 i. ___ Electronic Workshop – 2006 j. ___ Engineering presentation on CubeSat – Spring 2008 k.___ Amateur radio Faculty of Engineering tour (U of M) - 2008

Table 3.5: WinCube Project Participation (Continued)

40. Will you be participating in any of the following upcoming activities? (Check all that apply) a. Manitoba Space Adventure Camp July 2009 i. ___ Yes ii. ___ No Why or why not? b. BCube launch - June 2009 i. ___ Yes ii. ___ No Why or why not? c. BCube launch – Winnipeg Amateur Radio Club – June 30 2009 i. ___ Yes ii. ___ No Why or why not?
41. Since you have indicated that you have participated in the WinCube Project in at least one activity, are you willing to participate in a follow up questionnaire and survey? a. ___ No b. ___ Yes

Those students that indicated in Question 31 that they had participated in the WCP were asked in Question 39 (Table 3.5) what activities they did participate in. Further to that, continued interest in the WCP for these students were followed up with Questions 40 in relation to expected participation in upcoming WCP events. Question 41 was used to identify students that were part of the grade 10, five class sampling that had participated in the WCP in some capacity and ask if they would be willing to participate in the individual survey. Those students who had participated in the WCP and were known not to be part of the grade 10 grouping were asked to complete the survey and complete the individual survey.

3.4.9 Gender Differences

Gender differences as they relate to attitudes toward science, peers, extracurricular activities, interest, relevance and WCP participation will be dealt with as part of these main groupings.

3.5 Individual Interview

For those students that participated in some capacity within the WCP, the individual survey was used to get feedback on the WCP. The results will be presented as case studies in chapter 4. The individual interview questions were open-ended and are found in Table 3.6. The interviewer was instructed to use their discretion in pursuing clarification or additional information given student answers. The interviewer using the questions provided as a base, took notes on student responses.

Table 3.6: Individual Interview

1. How did you find out about the WinCube Project?
2. Describe the WinCube Project.
3. Why did you join the WinCube Project?
4. What were your expectations of the WinCube Project?
5. What do (did) you enjoy about the WinCube Project?
6. What do (did) you not enjoy about the WinCube Project?
7. Why did you remain involved with the WinCube Project?
8. Did you consider withdrawing from the project? If so, why?
9. Would you recommend the WinCube Project to other high school students?
    a. Why? Why not?
    b. If yes, who?

The WinCube Project has five fundamental goals. Please comment on whether or not the WinCube Project has met those goals during your participation.

10. GOAL 1: Provide authentic science and innovative research learning opportunities.
11. GOAL 2: Application of high level science, math and technology
12. GOAL 3: Enrichment for students to develop further interest in science and engineering
13. GOAL 4: Develop collaborative opportunities with post secondary institutions and/or industry on a local, national and international level

Table 3.6: Individual Interview (Continued)

14. GOAL 5: Raise profile of aerospace in schools and community
15. Has the WinCube Project met your expectations?
16. Has participation in the WinCube Project influenced your future career decisions or interests?
17. What suggestions do you have to improve the WinCube Project?

The individual interview questions relate to the main research questions in the following manner:

- Research Question 1: What factors influence student initial participation in the WCP?
  - Interview Questions: 1 to 4, and 9
- Research question 2: What factors influence student ongoing participation in the WCP?
  - Interview questions: 5 to 8, and 17
- Research Question 3: To what degree do participants of the WCP believe the fundamental goals of the WCP have been achieved?
  - Interview Questions 10 to 15
- Research Question 4: What influences does student participation in the WCP on future career aspirations?
  - Interview Question: 16

3.6 Evaluation Procedure

For the grade 10 group sample responses to question 38 on the questionnaire (*'Based on the above descriptions of WinCube, do you find the overall project appealing? Yes/No*) students will be categorize for data analysis. Those grade 10s who answered Yes to this question will be said to have a positive attitude toward the WCP and those answering No, a negative attitude toward the WCP. These will also be subcategorized into males and females with in each Yes/No groupings. The Analysis of the questionnaire will be done through a percentage breakdown and a comparison made between the groupings. The WCP existing participants will be analyzed as a group. Their comments to the individual interviews will be presented as a case study.

3.7 Summary

This chapter has described the research rationale for this project in that it focused on an extracurricular aerospace program for Manitoba high school students. The areas of interest for this research project presented in Chapter 2 have been paired up with specific questions from the questionnaire (found in Appendix C). A rationale for the pairing has also been presented. In the next chapter, the results of the grade 10 questionnaire sampling will be reviewed.

Chapter 4: Grade 10 Questionnaire Results and Discussion

4.1 Introduction

This chapter will analyze the results of the student questionnaire administered to the targeted grade 10 core classes in regards to the WinCube Project (WCP). The reasons students are interested in extra-curricular science programs are discussed in Chapter 2 (Literature Review) and include:

- Attitudes toward science
- Family
- Peers
- Extracurricular choices
- Interest and relevance
- Gender

This chapter will look at student responses to specific answers from the questionnaire and will pair them with the areas of interest as described in Chapter 3 (Methodology).

- Demographics
- Present education
- Future education
- Family
- Peers
- Extracurricular activities
- Interest and relevance
- WCP participation.

Each of these areas will be reviewed individually and a discussion of the findings and how they relate to the first research question of this project will be presented:

1. What factors influence student initial participation in the WCP?

This chapter will look at research question 1 using the written questionnaire as a vehicle for why students may or may not decide to choose an extracurricular activity like the WCP. The remaining three research questions will be addressed using the personal interview in Chapter 5.

For a detailed numerical breakdown of the results to the grade 10 questionnaire, please consult Appendixes D. This chapter will exclusively review and discuss the results of the questionnaire given to the grade 10 core classes. Chapter 5 will present the case studies of students who had participated in the WCP and partook in the questionnaire and individual interview.

4.2 Participant Categorization

Students who participated in this project consist of two categories: a group of students presently taking grade 10 core classes (Geography, English, Consumer Math, and Science (x3)) and those who participated in the WCP. The Students in the grade 10 core classes that volunteered to participate were asked to complete a questionnaire (Appendix C). The six targeted classes were chosen, because smaller groups within those classes were made aware of the WCP at some point of the year by their grade 10 Geography teacher (see Chapter 3, section 3.3 for a more detailed description). Using their responses to question 38: *Based on the above descriptions of WinCube, do you find the overall project appealing? Yes/No*, the students from the grade 10 core classes were broken into four groups:

- Female Yes (FY)
- Female No (FN)
- Males Yes (MY)
- Male No (MN)

Question 38 is used as central question to divide the students by determining whether or not they find the overall project appealing. Through separating them into 'interested', 'not interested' groupings it makes it possible to see if there are patterns that stand out among the two groups. Yes groups underlying factors can be established and compared to No group responses. It then may become clearer why students choose/not choose to participate in the WinCube project.

These categories were chosen since female and male yes' were classified as having positive attitudes toward the WCP and the female and male no's had negative attitudes toward the WCP. The mathematical treatment of the questionnaire results will compare the responses within a specific group using percentages. Out of the 56 females participating in the questionnaire, 20 were placed in the FY group and 36 in the FN grouping. For the 44 participating males, 11 were classified as MY and 33 as MN.

4.3 Demographics

Of the six targeted classes, the numbers of participants were 56 females and 44 males with an average age of 15.5 and 15.6 years of age respectively. The majority grade level of this group was grade 10 (95% for females, 95% for males)

4.4 Present Education

Question 4 of the questionnaire was aimed at getting information about the participant's present completed coursework. All of the grade 10 targeted group that were sampled had completed both grade 9 science and math. For those students that indicated that they had taken grade 11 courses were exclusive to those who were registered at the grade 11 level, but were taking one of the core grade 10 required classes in which the questionnaire was administered.

Unfortunately there was no significant data from question 4. During the analysis, it was noted that question 4 was too specific: *Please indicate which science and math* *courses you have completed at school.* There was a concern that if students were presently taking a math or science course (and therefore was not completed), would not reflect an accurate number in a specific grade 10 math or science class. The question should have read: *Please indicate which science and math courses you are presently taking or have completed at school.* The refined question would have provided more information and would include all current math and science courses. Data regarding student's current courses and future course selections was collected to allow the researcher the ability to ascertain if an interest in Science/Math is present. If students select Science and Math as subjects then they may view themselves a competent in these areas of study, and if they see themselves in this positive way, they may choose to be involved in activities were it in necessary to have these aptitudes for successful participation.

4.4.1 Student Perception of Space Education

Questions 28 and 29 provided feedback on student perceptions of space and space-related topics level of importance at the early/middle and high school levels. The results are found in Table 4.1. The general trend for all four groups was that 'some' and a 'little' contained the majority of responses for all groups.

- Question 28:
    - FY: 90%, FN: 86%, MY 82%, MN: 66%

- Question 29:
    - FY: 75%, FN: 81%, MY: 72%, MN: 60%

Table 4.1: Student Perceptions of Space and Space-Related Topics

Early/Middle Years	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
A lot	1	5%	1	3%	0	0%	0	0%
Some	10	50%	21	58%	2	18%	11	33%
A little	8	40%	10	28%	7	64%	11	33%
Nothing	0	0%	3	8%	1	9%	11	33%
No Answer	1	5%	1	3%	1	9%	0	0%
High School	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
A lot	3	15%	1	3%	0	0%	0	0%
Some	9	45%	14	39%	4	36%	11	33%
A little	6	30%	15	42%	4	36%	9	27%
Nothing	1	5%	5	14%	2	18%	13	39%
No Answer	1	5%	1	3%	1	9%	0	0%

The one group that had a significant percentage that felt there was no level of importance given to space and space-related topics was the MN group (Q. 28: 33% and Q. 29: 39%). The results from all four groups in regards to space education indicate that their exposure to the subject is minimal to adequate. None of the male groups indicated that *a lot* (the highest ranking for the importance) of space and space related topics: 0% for MY and 0% MN in early and middle school. For the female group in the earlier years '*a lot*' category the FY indicated a 5% response, FN 3% and in the high school importance in the '*a lot*' category increased only slight with 15% of the FY and 3% of the FN checking the *'a lot'* category. A similar student observation of the level of importance to space education was expressed by WCP participants (see section 5.21). FN responded that space topics are satisfactorily emphasized so student students showing a disinterest in space education may have resulted from a lack of exposure to the subject:

> If adolescents enter middle or junior high school with positive feelings toward science, and experience success during their initial courses in science, it is likely that they will elect to take and will be successful in additional science courses.

> This, in turn, leads to a positive commitment to science that influences lifelong interest and learning in science. If, however, a youngster receives little support from home, is exposed to little or no science in elementary school, and does not have positive experiences in science during the initial courses in middle or junior high school, he or she will likely attempt to avoid science and by the end of high school and lack both knowledge in and commitment to science.
>
> (Simpson & Oliver, 1990, p. 14)

Applying Simpson and Oliver's (1990) point about science education in general, perhaps student's lack of exposure to space topics in turn develops a disinterest in the subject. From this project's result, there may be a relation between the strong MN response of not finding the WCP appealing and the higher percentage feeling that was demonstrated in the minimal importance in their experience placed on space education. Students who do not feel an importance was given to their space education say it to be a reflection on the lack of exposure to the topic. If this is true then students will have little knowledge of the task. Minimal importance can be a reflection of nominal exposure to space related topics. If this it true Annek Vrugt & Zeeberg (2002) link student's lack of experience in a subject to their inability to determine if they are capable. In the case of joining the WCP student may not feel they have the background knowledge to excel and choose not to join.

The male no group's result along with the three remaining ones and their indicate that there isn't 'a lot' of importance given to Science topics, that perhaps students are under exposed to space related topics in their coursework. Despite the fact that in high school situation there is an entire unit devoted to Astronomy in the grade 9 science curriculum students still seem to be missing experience in science learning.(see Appendix B.2.1 for samples of prescribed learning outcomes for grade 9).

From a gender point of view, it appears that both female groups indicated a greater level of importance given to space-education in their previous school experience than the male groups. This result is inconclusive since it does not indicate whether the level of space-education was sufficient to them as an interested student.

4.5 Future Education

The decisions students make for future course selection in non-mandatory science electives provide insight into a student's self-perception. If they feel positively about their ability to learn science they will have a more positive attitude toward science (Talton &Simpson, 1986) and may choose an extracurricular activity like the WCP. For example, a student who requests an optional biology course may do so because they enjoy the subject or they feel the need it for future educational plans. Either way they must have self-confidence to choose the elective course and feel they could succeed in it.

4.5.1 Future High School Courses

The first question that looks at participating students' immediate future educational plans is Question 5: *Please indicate which science courses you plan to take at school in the future*. There are two initial comments about the results to this question. First, all respondents indicated they have completed their grade 9 math and science requirements and therefore this information is not included in Appendix D. Second, responses to question 5 in regards to grade 10 and 12 choices seem to have been disregarded. For grade 10 results, there was confusion on whether a student should indicate a future course as one they were presently taking, but had not completed yet. The data results become somewhat erroneous in this case. A similar issue arose for possible grade 12 courses. There were a number of responses in the evaluation where students would indicate they would register for grade 11 Pre-Calculus and not in grade 12. Students are required to complete a grade 12 level math course, and their failure to do so on the survey indicates a misunderstanding of the question. Similar responses occurred for grade 11/12 Chemistry and Biology. Because of the apparent confusion it was decided to focus exclusively on grade 11 results only.

In the grade 11 science and math courses, there was a significant difference in math selection between MY and MN groupings (see Table 4.2: Grade 11 Choices). For MY, 73% chose Pre-Calculus (18% for Consumer Math) while the MN group saw only 45% deciding on Pre-Calculus (58% for Consumer Math). It should be noted that students are free to choose both streams of math, but the MY significantly preferred Pre-Calculus over the Consumer math course. A similar occurrence occurred between FY (45% Pre-Calculus, 50% Consumer) and the FN (33% Pre-Calculus, 69% Consumer) on a lesser scale.

Table 4.2: Grade 11 Course Choices

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No Answer	0	0%	0	0%	1	9%	0	0%
Grade 11								
Consumer	10	50%	25	69%	2	18%	19	58%
Pre-Cal	9	45%	12	33%	8	73%	15	45%
Biology	18	90%	30	83%	7	64%	20	61%
Chemistry	11	55%	22	61%	7	64%	15	45%
Physics	6	30%	7	19%	5	45%	12	36%
Computer Science	0	0%	2	6%	2	18%	4	12%

For the sciences, variations between the other courses (Biology, Chemistry, Physics, and Computer Science) only revealed a around a 10% difference within the male and female groupings. Course selection has been associated with positive attitudes toward a particular field of study. The 10% variance between the groups is indicating that there is no significant difference in a course selection to indicate a predisposition to a course of study. Comparing the between the science across all student groups, Computer Science was the least favorite, followed by Physics, with Biology being the most popular. In the field of aerospace studies, often the most directly perceived related science subject is Physics and Pre-Calculus Physics. From the results in Table 4.2, it would appear few students are choosing Physics as an option, thus indicating a lower interest in an extracurricular aerospace activity like the WCP.

There is a gender difference in course selection between females and males as indicated in Table 4.2. There is a higher selection for biology by both female groups (FY = 90%, FN = 83%) than the male groups (MY = 64%, MN = 61%). The opposite was true for physics were both male groups had a greater interest (MY = 45%, MN = 36%) compared to females (FY = 30%, FN = 19%). This gender difference between females and males for level of interest between biology (females) and physics (males) has found similar results in other research projects (Farenga & Joyce, 1999; Jones et al., 2000; Osborne & Collins, 2000). The implication for the WCP is it's programs are primarily based in the field of physics which would suggest that the males would show more of an interest in the activities offered.

4.5.2 Post-Secondary Decisions

Question 8: *When I graduate from high school, I plan to* showed a higher percentage for those in the Yes categories (FY and MY) to attend university than those in the No groups (FN and MN) (see Table 4.3: Post-Secondary Plans).

Table 4.3: Post-Secondary Plans

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
To Work	1	5%	3	8%	1	9%	8	24%
College	4	20%	12	33%	1	9%	12	36%
University	15	75%	21	58%	9	82%	13	39%
No Answer	0	0%	0	0%	0	0%	0	0%

A major difference in post-secondary decisions occurred between the MY and MN groups in choosing university as their primary goal, MY at 82% compared to 39% for MN. The female group also showed a drop in interest in University from Yes and No respondents: FY 75%, FN 58%. For those planning to attend college, the No groups displayed a larger ratio than the Yes groups. Again, the most significant difference for college attendance occurred between MN (36%) and MY (9%). The female difference was FN 33% to FY 20%. There is a strong indicator that males who may be interested in a program like the WCP have a higher tendency to plan to attend University in the future. This statement can also be said to a lesser extent for the females.

4.5.3 Courses to be taken at University/College

Question 10: *When you go to university/college, do you intend to take any courses in the following disciplines* which included Physics, Chemistry, Biology, and Computer Science. Table 4.4 shows the results for this question.

Table 4.4: University and College Math and Science Course Selections

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Physics	7	35%	5	14%	4	36%	9	27%
Computer Science	5	25%	3	8%	1	9%	4	12%
Engineering	0	0%	0	0%	4	36%	7	21%
Astronomy	1	5%	1	3%	2	18%	3	9%
Math	8	40%	16	44%	5	45%	10	30%
Biology	12	60%	16	44%	6	55%	10	30%
Chemistry	11	55%	15	42%	6	55%	7	21%
No Answers	0	0%	9	25%	4	36%	7	21%

Table 4.4 shows that students from the Yes groupings had a greater interest in taking science courses than those from the No groups. It should also be noted that interest in Astronomy coursework was extremely low among all groups. Both male groups showed an interest in the field of engineering, where females did not. Students with an interest in science courses in post-secondary settings were more likely to indicate an interest in the overall appeal of the WCP.

The gender difference for preference in studying physics or biology at university begins to show similar results. Both the Yes and No groups indicate a comparable interest in university physics (FY = 35%, MY = 36%, FN = 14%, MN = 27%). University/college biology had equivalent indications of appeal among the Yes and No groups (FY = 60%, MY = 55%, FN = 44%, MN = 30%). These results would indicate no difference in preference between female and male groups towards studying physics, and therefore both could become involved in the WCP.

When comparing the results of courses intended to be taken at the high school (HS) and those in university or college (U/C), a number of similarities and differences occurred (Table 4.5: Comparing High School to University/College Science Course Selections).

Table 4.5: Comparing High School to University/College Science Course Selections

Courses	Female Yes	Female No	Male Yes	Male No
HS Physics	30%	19%	45%	36%
U/C Physics	35%	14%	36%	27%
HS Chemistry	55%	61%	64%	45%
U/C Chemistry	55%	42%	55%	21%
HS Biology	90%	83%	64%	61%
U/C Biology	60%	44%	55%	30%
HS Computer Science	0%	6%	18%	12%
U/C Computer Science	25%	8%	9%	12%

There are slight drops in the number of students intending to take Physics and Chemistry between high school and university/college. The largest drop occurring in both No groups in their transition to university/college. A unique feature of the data is the significant drop in interest in Biology for the FY, FN, and MN groups between high school and university/college. Female yes said yes to high school biology 90%, and then the number drops to 60% at the post-secondary level. In the female no category 83% selected high school biology as a future course and 44% for after high school study. The male yes category number drops in high school Biology from 64% to 55% after school and the male no goes from 61% in high school for Biology as an elective to 30% for the future study plans. An implication of this result is that student course selection at the high school level may not be a strong indicator of post-secondary study. What a student studies in high school may not actually be part of their long-term goals.

The interest in Computer Science is also fairly consistent amongst three of the groups (FN, MY, and MN). The anomaly occurs in this field of study for the FY group that showed no interest in Computer Science at the high school level, but there is a sudden jump at the university/college level (FY: HS = 0%, UC = 25% and FN: HS = 6%, UC = 8%).

4.5.4 Fields of Study at University/College

Question 9: *Please state the field of study you plan to enter at university/college* is summarized in Table 4.6: Fields of Study at University/College. A more detailed listing is found in Appendix D.

Table 4.6: Fields of Study at University

Areas of Study	Female Yes	Female No	Male Yes	Male No
Science/Math	55%	36%	45%	12%
Liberal Arts	15%	36%	36%	15%

Table 4.6 reflect the accumulated responses to university field of study interest by all four groups. The responses were grouped according to whether they would consider a field of study in Science/Math or Liberal Arts. The results show that both Yes groups (FY and MY) have a higher percentage of students continuing their studies in the field of Science/Math than the Liberal Arts. Both Yes groups also have a greater interest in Science/Math than their No counterparts (FN and MN). Student interest in the WCP may be linked to an interest in math/science. In evaluating the fields of study at the college level, there was no significant pattern discernable with respect to student choices.

Females have indicated an interest in science and math fields of study at a rate equal to (FY = 55%, MY = 45%) or more than (FN = 36%, MN = 12%) their male counterparts. This result is counter to some research that found males to have more positive attitudes towards science education and careers (Crettaz von Roten, 2004; Miller et al., 2006).

4.5.5 Post-University/College Careers

Table 4.7: Post-University Careers summarizes responses to question 11: *Please indicate the career you would do after graduating form university/college.*

Table 4.7: Post-University Careers

Career Fields	Female Yes	Female No	Male Yes	Male No
Science/Math	60%	28%	45%	15%
Liberal Arts	15%	31%	36%	24%

Student responses to question 11 were again classified as science based (ex. Medical field) or liberal arts (ex. Lawyer, journalist). The results are consistent with Table 4.6: Fields of Study at University/College shows that the Yes groups have a greater interest in occupations in the science/math field than the liberal arts. Both Yes groups have higher percentages that are planning on entering science related fields than their No counterparts. It should however be pointed out that the Yes group's positive responses for science careers are primarily in the medical field, not related directly to the aerospace industry.

4.5.6 Post-Secondary Careers

The results for post-college careers and those who responded to question 12: *Please state the occupation you plan to work at after graduating from high schoo'* showed no significant categorization based on their varied answers (See Appendix D for a detailed breakdown of answers). Question 12 asked students to identify if they did not intend to go to university or college after graduating from high school. It should be noted that although Table 4.6: Fields of Study at University/College and Table 4.7: Post-University Careers indicate that both the FY and MY groups are consistent in their choices for coursework and careers in the field of science. The majority of professions sought by the FY and MY groups are in the medical field and not in the physical sciences that are associated with aerospace.

The conclusions regarding future education choices show that the Yes groups have a greater interest in attending university than their No counterparts. The Yes group also demonstrate a stronger interest in studying sciences than the No groups which remains fairly consistent between high school and university or college. It would appear that the Yes groups positively view their abilities in the fields of science and math and may be more likely to join the WCP than the No respondents.

4.6 Family

Family has been shown to have a strong influence on a student including academic decisions they make (Anderson et al., 2003; Tocci & Englehard, 1991; Simpson & Oliver, 1990; Talton & Simpson, 1986; Simpson & Troost, 1982). This next section will look at the home life of students participating in the questionnaire component of this study to see if there are any contributing factors overlying student attitudes to science and the decisions students make based on certain mind-sets.

4.6.1 Family University/College Degrees

The first is question 15: *The following family members have degrees*. The summaries of results are presented in Table 4.8 with a breakdown of the many family members who were reported to have degrees within the household in Table 4.9. For more details on specific results, please see Appendix D.

Table 4.8: University/College Degrees at Home

Family Member	Female Yes	Female No	Male Yes	Male No
Mother	50%	53%	55%	39%
Father	55%	44%	36%	36%
Sister(s)	30%	6%	0%	9%
Brother(s)	25%	11%	0%	9%

Table 4.9: Family Members With University/College Degrees Within Household

Number of Family Members In Home	Female Yes	Female No	Male Yes	Male No
1	25%	19%	18%	27%
2	45%	19%	45%	18%
3	0%	11%	0%	6%
4	5%	3%	0%	3%
No Answer	25%	42%	27%	45%

Focusing on the mother/father results found in Table 4.8, there is no real significant difference between the male and female categories (range difference of 7% to 16%). The study difference is seen in Table 4.9 where FY and MY have significantly higher reports of at least two family members with university or college degrees within the household. There is also a significant number of students reporting *no answer* for family members with degrees in the FN (42%) and MN (45%) groups.

4.6.2 Homework Help

Parental interest in science education has a positive affect on student attitudes toward science. Influences can include parents watching TV, reading, or surfing the internet on scientific related topics. They can also display interest in a students learning by being available to help with homework or taking the family on science related excursions. For question 16: *Do you get help with your science homework at home?*, the majority of respondents said no they did not get help with their homework (Table 4.10) with a slightly higher report of Yes in the FY grouping.

Table 4.10: Help With Homework at Home

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	12	60%	27	75%	8	73%	23	70%
Yes	8	40%	9	25%	3	27%	10	30%

4.6.3 Space-Related Television

The home environment and how students spend their time in science related activities may provide some insight into student's attitudes toward science. Starting with question 17: *How often do you watch scientific television programs or documentaries related to space topics*, the FY (70%), FN (86%) and MN (69%) report seldom to never (Table 4.11). Only the MY group (54%) reported frequently to always.

Table 4.11: Frequency of Students Watching Space-Related Television Programs

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	0	0%	0	0%	2	18%	2	6%
Frequently	5	25%	5	14%	4	36%	8	24%
Seldom	7	35%	18	50%	3	27%	11	33%
Never	7	35%	13	36%	3	27%	12	36%
No Answer	1	5%	0	0%	0	0%	0	0%

The following are comments made by students in the open ended response section of questions 17:

Negative Comments:
- Not interested
- Boring
- No time
- Don't like watching
- No cable
- Rarely watch TV
- Parents control TV
- Something better on
- If I need to know about it
- Don't have channels

There were no significant positive comments recorded in the questionnaire to report on for this question. As for family influences with regards to TV, question 18 asked: *Does anyone else at home watch scientific television programs or documentaries related to space topics?* Table 4.12 shows that the majority of households had no one interested in watching space-related television: FY (70%), FN (58%), MN (79%). Only

MY reported a significant number of family members watching scientific programming (64%).

Table 4.12: Family Members Reported Watching Space-Related Television

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	14	70%	21	58%	4	36%	26	79%
Yes	6	30%	15	42%	7	64%	6	18%
No Answer	0	0%	0	0%		0%	1	3%

4.6.4 Space-Related Printed Media

Student exposure to the printed press was asked in question 19: *How often do you read a scientific article related to space in the printed press?* All four groups responded (Table 4.13) overwhelmingly seldom to never: FY (95%), FN (97%), MY (72%), and MN (94%).

Table 4.1: Frequency of Students Reading Space-Related Topics in Printed Press

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	0	0%	0	0%	1	9%	0	0%
Frequently	1	5%	1	3%	1	9%	3	9%
Seldom	8	40%	12	33%	4	36%	10	30%
Never	11	55%	23	64%	4	36%	21	64%
No Answer	0	0%	0	0%	1	9%	0	0%

Highlights of comments made by the four groups in regards to the printed media are as follows:

Positive Comments:

- Whatever I find
- Mostly on the internet. I search up stuff regarding CERN atom smasher
- I want to know daily happenings
- A little interested but I don't spend the effort to search it up or anything like that

Negative Comments:

- Not interested
- Too busy
- No time
- Boring

- Does not relate to me
- Never appeals to me
- Astronomy doesn't interest me as much as biology
- I don't like reading articles like that
- Just doesn't come up that often
- I don't really read the paper or magazines that would talk about that stuff

Access to Printed Material:

- No access
- I read them in science class for an article assignment
- Articles my teacher hands out
- Never really see them
- Mostly on the internet.

Student access to printed material included magazines (National Geographic, Discover), newspapers, science class readings (textbook, articles supplied by the teacher) and the internet. It is interesting to note that some students consider the internet to be a source of print media.

The negative comments students made concerning print media provides some insight into student interest and relevance of the topic of aerospace. If there is no interest in a particular subject area (i.e. find it boring, not interested, etc.), then students will not want to participate in an extracurricular activity that focuses on that subject area. The issue of time was listed as a factor for why some students do not participate in research activities with respect to TV, print media, and as you will see in the following sections of this chapter, internet surfing and WCP participation. In Chapter 2, there was a discussion on how time may influence a student's choice on what extracurricular activities to participate in (Eccles, 1994; Larson & Verona, 1999).

The majority of family members do not read scientific articles related to space. Question 20: Does anyone in your home read scientific articles related to space in the printed press had similar responses as question 18 that asked students to comment on family interest in watching space-related television.

Table 4.2: Family Members Reported Reading Space-Related Articles

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	12	60%	28	78%	9	82%	25	76%
Yes	7	35%	6	17%	1	9%	6	18%
No Answer	0	0%	2	6%	1	9%	1	3%

4.6.5 Space-Related Internet Activity

A number of students indicated in their open responses to question 19 that they read space-related articles on the internet. Question 21: *How often do you surf internet sites related to space topics*. The majority of responses (Table 4.15) indicated seldom to never: FY(85%), FN (87%), MY (72%) and MN (75%).

Table 4.3: Student Space-Related Internet Activity

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	1	5%	1	3%	1	9%	2	6%
Frequently	2	10%	2	6%	2	18%	3	9%
Seldom	9	45%	11	31%	4	36%	10	30%
Never	8	40%	20	56%	4	36%	15	45%
No Answer	0	0%	0	0%	0	0%	3	9%

Some of the comments students made in their open responses follow:

Negative Comments:

- Not interested
- I'm not a nerd, when I'm at home and I go on the computer I go to Face book and stuff like that
- Because I have textbooks for it
- Waste of time unless for homework I do
- Only when I have a project
- Boring
- I have no time
- It's not fun

- I never see any space/science related things while browsing the internet
- I don't go on the computer that much
- No computer

The samples of comments listed above are similar negative comments to space-related content described in section 4.6.3 television and 4.6.4 print media. For example, 'its boring', 'not interested' or 'have no time'.

Responses to question 22: *Does anyone in your home surf internet sites related to space topics* continues to demonstrate a lack of interest of family members in regards to space related topics. Table 4.16 shows in each category family members not surfing the internet for space-related topics.

Table 4.4: Family Space-Related Internet Activity

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	17	85%	33	92%	9	82%	28	85%
Yes	3	15%	3	8%	1	9%	4	12%
No Answer	0	0%	0	0%	1	9%	1	3%

When comparing the results from family space-related interest in television, print media, and internet sites, it becomes clear that there is very little display of positive attitudes towards space science with any of the following sources (Table 4.17).

Table 4.5: Comparative Results for Family and Various Space-Related Sources

Space-Related Source	FY	FN	MY	MN
No to TV	70%	58%	36%	79%
No to Print	60%	78%	82%	76%
No to Internet	85%	92%	82%	85%

4.6.6 Family Space-Related Activities Outside of Home

A strong indicator of family interest in science as a family collective comprises of visitation to activities outside the home like science museums and planetariums.

Question 23 asks: *Do you do science related activities outside your home with your family?* For the four groups, most do not (Table 4.18).

Table 4.6: Science Activities Outside of the Home

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	11	55%	30	83%	8	73%	29	88%
Yes	9	45%	5	14%	3	27%	3	9%
No Answer	0	0%	1	3%	0	0%	1	3%

For those students who said yes, they often cited the Planetarium, Manitoba Museum, and science centers as family destinations. There was a significant difference in Yes answers for the FY group (45%) compared to the FN (14%) and to a lesser extent between MY (27%) and MN (9%).

4.6.7 Science Movies

The final question on family influences, question 24, was used to identify on student attitudes toward science, *How often do you go to the theatre to watch science fiction movies about space and space related topics?* The majority of each group indicated (Table 4.19) that they seldom or never did so: FY (100%), FN (100%), MY (81%) and MN (84%).

Table 4.7: Science Fiction Movie Attendance

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	0	0%	0	0%	1	9%	2	6%
Frequently	0	0%	0	0%	1	9%	2	6%
Seldom	10	50%	8	22%	4	36%	13	39%
Never	10	50%	28	78%	5	45%	15	45%
No Answer	0	0%	0	0%	0	0%	1	3%

Comments made by students to question 24 can follow:

Negative Comments:

- No time
- Not interested
- Boring
- Don't go to the movies
- There's none to watch
- Not allowed
- We don't have the money to take all 8 of us to places
- Because we rather go watch some good movies

Again, student responses are similar to those made about space-related TV, printed material, and internet sites. Many are not interested or find the topic of space to be boring. There was one particular comment made by students in the questionnaire relating to television, print media, internet, movies and no time. Eccles (1994) describes the "potential cost of investing time in one activity rather than another" as a variable that impacts a person's achievement related choice. What could be competing for a students time in regards to the activities mentioned in the questionnaire? Larson and Verma (1999) identify high school students with low participation rates in extracurricular math and science activities would rather hang out with friend, work or engage in other activities. In section 4.10 a number of students cite work as a reason for not being able to participate in WCP activities. This section has reviewed the possible input family may have on student attitudes toward space, and joining WCP. Family is important because it can impact a student's affective experience" (Anderson et. al, 2003 p. 253). The areas surveyed is an attempt to evaluate the affective experiences.

> If adolescents enter middle or junior high school with positive feelings toward science, and experience success during their initial courses in science, it is likely that they will elect to take and will be successful in additional science courses. This, in turn, leads to a positive commitment to science that influences lifelong interest and learning in science. If, however, a youngster receives little support from home, is exposed to little or no science in elementary school, and does not

> have positive experiences in science during the initial courses in middle or junior high school, he or she will likely attempt to avoid science and by the end of high school and lack both knowledge in and commitment to science.
>
> (Simpson & Oliver, 1990, p. 14)

Based on student responses to the questionnaire, there does not seem to be any relationship between the yes and no groups when it come to homework, television, print media, the internet and science movies. Where home influences show a significant difference are when two family members within a household held a college degree (each FY and MY) and were involved in science activities outside of the home. In Chapter 5, a similar result occurs for students that have participated in the WCP.

4.7 Peers

Peers have been shown to have an influence on student attitudes toward science and their choice of extracurricular activities. (Fredricks & Eccles, 2005; Eccles & Barber, 1999; Simpson & Troost, 1982) Question 25: *What three courses are your closest friends' most favorite subjects in high school* and question 26: *What three courses are your closest friends' least favorite subjects in high school* are used to uncover possible influences peers have on student decisions. The question were used to see if a positive relationship between student's peers with positive attitudes toward science (ie favorite subject being science) would affect a student's favorable view of the WCP (ie. FY and MY groups). For question 25 and 26, student were asked to list their top three answers (detailed responses are found in Appendix D). Eight general categories were created to help with the analysis:

- Science (Physics, Chemistry, Biology)
- English
- Social Studies (Geography, History)
- Math (Pre-Calculus, Consumer)

- Performing Arts (Drama, Band, Choir)
- Gym
- Technical Applied Arts (TAA) (Auto, Graphics, Drafting, Woods, Metals)
- Other

Table 4.20 and 4.21 illustrates the cumulated results for the three responses to each question, ranking the responses in order of preference for each group.

Table 4.8: Peer Favorite Subjects

FY	FN	MY	MN
Gym – 21%	English – 17%	Gym – 30%	No Answer– 23%
Math – 18%	Science – 16%	Math – 15%	Performing Arts – 13%
English – 15%	Performing Arts-15%	Science – 12% TAA – 12% Performing Arts–12%	Science – 12% Gym – 12% TAA – 12%
No Answer – 13%	No Answer – 11%	English – 9%	Other – 8%
Performing Arts–8%	Math – 10% Gym – 10%	Other – 6%	Math – 6% Social Studies – 6%
Science – 7% TAA – 7%	TAA – 9%	Social Studies – 0%	English - 5%
Other - 3%	Other – 8%	No Answer – 0%	
Social Studies - 2%	Social Studies - 4%		

Table 4.9: Peers Least Favorite Subjects

FY	FN	MY	MN
Science – 25%	Math – 22%	Science – 30%	No Answer – 37%
Math – 18%	Science – 19% Social Studies– 19%	Math – 27%	Science – 15% Math – 15%
English – 13% Social Studies – 13% No Answer – 13%	No Answer – 9%	Social Studies – 24%	English – 9% Social Studies – 9%
Performing Arts – 8%	English – 8%	English – 12%	Gym – 8%
Gym – 3% TAA – 3%	Gym – 7%	Performing Arts – 3% Gym – 3% TAA – 3% Other – 3%	TAA – 4%
Other - 2%	Performing Arts – 5% Other – 5%	No Answer - 0%	Other – 3%
	TAA - 2%		Performing Arts - 1

For both Yes groups, the top two peer favorite subjects were Gym and Math. If we disallow MN's 'No Answer' for Table 4.20, then both No groups list their friends second favorite subject is Science (FN – 16%, MN – 12%). Looking at Table 4.21, all four groups place Math and Science as their peer's least favorite subject (again disallowing the MN group's 'No Answer' response).

These results contradict existing research that indicates "best friends and significant others who like or dislike science may be strong influences on students' attitudes toward science" (Simpson & Troost, 1982, p. 769). If Simpson and Troost's (1982) findings were true, then both the FY and MY groups should have placed Science higher as a peer favorite subject and lower on the least favorite. This did not occur. Similar results occurred wit the WCP participants (see section 5.4.4) The only consistent point with Simpson and Troost is both the FN and MN groups placed Math and Science as their peer's least favorite subject.

4.8 Extracurricular Activities

An area of interest for this investigation was to establish what extracurricular activities students were presently participating in and out of school. Questions 13 and 14 on the questionnaire were used to note the extracurricular activities. The summary of results for question 13: *Please indicate all activities that you are involved with at school* can be found in Table 4.22. Question 14: *Please indicate all activities that you are involved with outside of school* results are presented in Table 4.23. The results are categorized using Eccles and Barber's (1999) classification system of extracurricular activities as discussed in Chapter 2.

- **Prosocial activities** – attending church and/or participating in volunteer and community service type activities
- **Performance activities** – participating in school band, drama, and/or dance
- **Team sports** – participating in one or more school teams

- **School involvement** – participating in student government, pep club, and/or cheerleading
- **Academic clubs** – participating in debate, foreign language, math or chess clubs, science fair, or tutoring in academic subjects

(Eccles & Barber, 1999, p. 14)

Table 4.10: School Extracurricular Activities

Activity	FY	FN	MY	MN
Academic	0%	0%	0%	0%
Sports	30%	39%	91%	100%
School Involvement	45%	8%	18%	6%
Performance	25%	33%	100%	18%
Students in at least one activity	65%	58%	64%	58%

Of the students sampled at the targeted school, 60% had participated in at least one extracurricular activity at school (females – 61%, males – 59%). The results are slightly lower than those reported by Eccles and Barber (1999) with 69%, and significantly lower than Gadbois and Bowker (2007) at 98.5%. Table 4.23 highlights the amount of involvement in extracurricular activities outside of school.

It was identified in Chapter Two that females tend to choose biology over physics because they seem to prefer activities with a high social relevance (Reid & Skryabina, 2003). This is apparent from the data in Table 4.22 where 45% of the FY group have participated in school involvement activities (student council, social rights groups) than the male groups (MY = 18% and MN = 6%).

Table 4.11: Outside School Extracurricular Activities

	FY	FN	MY	MN
Academic	0%	0%	0%	0%
Sports	20%	17%	27%	14%
Performance	15%	11%	27%	18%
Prosocial	35%	25%	27%	15%
Work	5%	14%	0%	6%
Students in at least one activity	10%	83%	64%	67%

Extracurricular participation outside of the school was 65% of the sampled group. The 65 % was calculated by taking the total number of students involved in outside activities and dividing that number by the students who completed the questionnaire. Looking at both in and out of school participation, males tend to participate in school sport activities at a higher rate than females. Tables 4.22 and 4.23 also indicate that there is no participation in academic activities in and out of school.

Table 4.12: Student Participation in Both In and Out of School Extracurricular Activities

	FY	FN	MY	MN
Both	45%	50%	55%	48%
None	20%	6%	0%	12%

Table 4.24 shows that of the sampled students, 49% participated in both in and out of school extracurricular activities and that only 10% in no activities at all (this calculation was derived by adding the number of students who participated in in-school and out of school activities and dividing that number by the number of respondents) . For the grade 10 sample, students are participating in extracurricular activities both in and out of school. Given that the majority of grade 10 students indicate they are involved in extracurricular activities, time available to participate in the WCP may be a deterrent to join.

4.9 Interest and Relevance

Data was generated on student subject interest through Question 6: What are your three favorite subjects in high school and What are your three least favorite subjects in high school. A detailed breakdown of responses can be found in Appendix D. Student answers were categorized and processed in the same manner as described in section 4.7: Peers. Table 4.25 displays the results for favorite subjects and Table 4.26 least favorite.

Table 4.13: Student Favorite Subjects

FY	FN	MY	MN
Science – 23%	Science – 17%	Performing Arts – 30%	Science – 17%
Math – 22%	English – 16%	Gym – 18%	Math – 16%
English – 17%	Performing Arts – 15%	Math – 12% Other – 12%	TAA – 15%
Performing Arts – 13%	Gym – 13% TAA – 13%	Social Studies – 9%	Gym – 14%
Gym – 7% TAA – 7%	Math – 11%	Science – 6% English – 6%	Social – 9%
Social Studies – 5% Other – 5%	Social – 8%	TAA – 3%	English – 8% Performing Arts – 8% Other – 8%
No Answer - 0%	No Answer – 6%	No Answer - 0%	No Answer - 5%
	Other – 5%		

Table 4.14: Student Least Favorite Subjects

FY	FN	MY	MN
Social Studies – 23%	Science – 24% Math – 24%	Math – 24%	No Answer – 21%
Science – 20%	Social Studies– 15%	Social Studies – 21%	Math – 18%
Math – 17%	English – 14%	Science – 15% English - 15%	Science – 17%
English – 12%	Gym – 9%	Other – 9%	English – 15%
Gym – 8%	No Answer – 8%	Performing Arts - 3% Gym – 3% TAA - 3% No Answer - 3%	Social Studies – 13%
Performing Arts – 3% TAA – 3%	Performing Arts – 6%		Other – 4%
Other – 2%	Other – 2%		Performing Arts – 3% TAA – 3%
No Answer - 0%	TAA - 1%		Gym – 2%

There is some difficulty in arriving at any conclusion from this data in respect to math and science interest. For groups FY, FN and MN, they all list science in the top three favorite and least favorite at the same time. Similar results were found for FY and MN with Math. A more consistent result occurred for FN that listed Math as sixth favorite subject and first for least favorite. The MY group preferred performing arts (first favorite/ sixth least favorite) and Math (third favorite/first least favorite) and Science (sixth favorite/third least favorite). Fredricks, Davis-Keen and Eccles, (2006) showed that students who enroll in elective math and science classes show a strong interest and belief that there subjects are important. Based on this mixed response to favorite and least favorite courses with respect to science and math, perhaps this sample does not believe science is important. If that is true then these students would be less likely to participate in science and math activities like the WCP.

The questionnaire aims to search for student interest in space by asking Question 27: *List your three favorite topics relating to space*. Major categories were created based on student responses:

- Astronomy (Big Bang, Star formation, Black Holes)
- Planetary Geology (Moons, Planets, Earth)
- Extraterrestrials (Aliens, U.F.O.s)
- Physics (Dynamics, Kinematics, Satellites, Rocketry)
- Biology (life on other planets, Earth Ecosystem and Weather)
- Astrology

Table 4.27 lists in order of preference, the responses for each group.

Table 4.15: Favorite Space Related Topics

FY	FN	MY	MN
No Answer-60%	No Answer - 60%	No Answer - 39%	No Answer – 67%
Planetary Geo. – 10% Biology – 10%	Astronomy – 19%	Astronomy – 18% Physics – 18%	Astronomy – 13%
Astronomy – 8%	Planetary Geo. – 18%	Planetary Geo. – 9 % Biology – 9%	Planetary Geo. – 9%
Physics – 7%	Physics – 7%	Astrology – 3%	Extraterrestrial – 5%
Extraterrestrials - 5%	Extraterrestrial – 6%	Extraterrestrial - 0%	Physics – 3%
Astrology - 0%	Biology – 3%		Biology – 2%
	Astrology - 2%		Astrology – 0%

There were a very large number of no responses to either the entire question or subsequent rankings within the question. It appears that students lack the experience in space as a topic and find it difficult to generate a response at all. The survey results earlier in the questionnaire seems to point in this direction as well, when students responded to the Likert scale questions *How much importance do you feel has been given to space and space related topics in the context of your high-school/early and middle school education* (Q 28/28). The response *a lot* was never indicated by the male group with 0% indicating that it was important in early and middle/senior years, the females indicated that some emphasis was place on space related topics with 5% of the time for FY respondents and 3% for FN in early years and 15% FY and 3% FN for high school.

Relevance may also come into question if student's responses do not indicate a practical application of an activity to future plans. Students indicated Extraterrestrials and Astrology as possible space topics, but if young people do not see space as practical they may not choose it as a possible course of study or extracurricular activity. Those that did respond focused on Astronomy and Planetary Geology as their primary choices. The MY group did indicate a greater interest in Physics. The listing of space related favorite choices (Extraterrestrial, Biology, and Astronomy) does not in general match that of the WCP offerings (Satellites, Atmospheric Studies, and Rocketry). This may create incongruency between high school interests and the WCP activities.

4.10 Interest in the WinCube Project

As stated in section 4.2, students participating in the questionnaire component of the project were broken into two main groups – male and females. The two groups were further broken into subgroups based on question 37: *Based on the above descriptions of WinCube, do you find the overall project appealing?* Overall, 36% of females said they found the WCP appealing while 25% of males said yes.

4.10.1 Pillars of Education Interest

The WCP has six main educational opportunities it offers to participating students.

The 'pillars of education' are:

- CubeSat (Picosatellite)
- BCube (High altitude balloon payloads)
- Amateur Radio
- WinGS (WinCube Ground Station)
- MSAC (Manitoba Space Adventure Camp)
- IADC (Introductory Aerospace Design Course)

In the questionnaire, a brief description of each pillar was provided. Only the IADC was omitted from the survey because it is an advanced course offering of the WCP. The five other pillars are considered entry level. Each of the five chosen areas were included in the following generic form of questions 32 to 36, *Based on the description of the "activity", would you ever consider joining this component of the WinCube Project?* The results for questions 32 to 36 are found in Table 4.28.

Table 4.16: Interest in WinCube Pillars of Education

Activity	FY	FN	MY	MN
CubeSat	60%	14%	45%	12%
BCube	60%	6%	45%	15%
Amateur Radio	45%	8%	27%	9%
WinGS	55%	8%	18%	9%
MSAC	60%	6%	55%	9%

Using the largest percentages of the FY and MY groups, it appears that the three most popular pillars of the WCP are CubeSat, BCube, and MSAC. These are also supported by the highest percentages of the FN and MN groups.

Comments made by the students in regards to each pillar follow and may come from any of the respondents in the yes or no categories. The comments are included to give a general student perception of the WinCube Project. Comments will be presented first with similar remarks made to all five, followed by student commentary made specifically to each pillar.

Looking specifically at the results for both Yes groups, it is interesting to note that the FY group displayed greater levels of interest in all WCP activities than the MY groups. This result is contrary to other research which indicates that females tend to prefer activities with a high social relevance rather than a high mechanical or practical relevance (Reid & Skryabina, 2003), like the WCP is.

4.10.2 Generic WinCube Pillar Comments

The following are general negative comments made in regards to the WCP. It should be noted that the negative comments made here are from similar comments made in regards to all five pillars that were questioned.

- Not interested
- Better things to do
- Boring
- No time
- Working
- I don't like space
- Don't like it
- Don't care
- Don't like space

The following are general positive comments made in regards to the WCP. The first five comments were made frequently while answering questions 32 to 36. The remainder were given as the open ended response to question 37, *Based on the above descriptions of WinCube, do you find the overall project appealing*:

- Sounds interesting
- Exciting
- Sounds fun
- amazing
- Its cool

- (Yes) But I wouldn't be able to commit
- Some of it interests me, some of it doesn't
- Yes, I do but I'm not interested. It sounds great for others though.
- I choose yes because if I were really smart and really into science I would be all for this
- Its interesting, exciting and a really great experience that's filled with opportunities
- Yes because it would be cool for nerds, but not for me.
- Its something really neat, not a lot of people would get to do.
- It feels like it has a lot to offer and I can learn a lot from it
- It sounds like certain people could like doing it but not me.
- This could be a useful experience for me and because it is all about science, I know I will enjoy it.
- It's a great proposal for students dedicated to science

The negative comments reflect a general disinterest in the subject of aerospace. The positive comments are a sign of two things: an interest in the field of study, and a unique opportunity to try out new things and develop new skills. Specific comments in regards to each of the five pillars are presented next.

4.10.3 CubeSat Comments

Positive comments about CubeSat:

- Sounds like it would be a great experience
- It sounds cool, just interests me
- Because I want to learn more about it and it seems very exciting
- It seems to be pretty interesting. It seems like a good experience for people to learn from
- Hands on projects really interest me, and anything in the field of science interests me

Negative comments about CubeSat:

- No – Everything gets more complicated/complex as you start to know more about it
- No one thinks science is cool, so as far as they know I don't either
- I am not interested in space engineering
- I wouldn't want to because it doesn't really give me benefits for what I want to do in the future
- It's interesting, but I can't commit

- No because I am not good at science and also I am not interested
- I choose no because I'm not really into scientific things
- I'm not interested in science and it is not one of my strong subjects
- I'm not interested in aerospace, and I would not want to spend my time learning about it.

The general positive comments again reflect a general interest and opportunity to develop new skills and knowledge. The negative comments begin to reflect issues around relevance to future educational and career goals and self-efficacy about being able to work effectively in the CubeSat environment.

4.10.4 BCube Comments

Positive comments about BCube:

- Sounds cool and a neat way to learn
- Because they all fit on what I want to try
- It sounds pretty fun to launch things into the atmosphere
- Because I'd like to do tracking when in flight be on a mission
- Because I think its going to be so fun doing this project
- Like I said science and hands-on-work interest me

Negative comments about BCube:

- I choose no because I don't really like space it means to me that there is only more things to learn about.
- Because it does not appeal to me, I'm more of a math guy
- It involves too much experimenting for me. I don't feel its fun.
- I don't care about things that go on in aerospace industry and I don't want to spend my time learning about it
- No –to much work – could equal a fail

The general positive comments seem to reflect an interest in more of the individual hands-on experience that may not have been as attainable in the CubeSat portion of the WCP. The negative comments this time focus on hands-on activities as a bad thing. Self-efficacy and the lack of desire to commit to a hands-on project emerges.

4.10.5 Amateur Radio Comments

Positive comments about Amateur Radio:

- Yes I would maybe consider it because it would be cool to be able to operate the radio tracking equipment
- It would be awesome to communicate with satellites
- I would love to be on amateur radio
- It could help with the Earth
- Receiving my radio license sounds interesting

Negative comments about Amateur Radio:

- I don't want to be on the radio
- Not really interested in the radio active field
- I choose no because anything technical is too confusing for me
- It seems it would be hard to work with this kind of topic
- I would never use it
- Doesn't interest me because it has nothing to do for what I'm gonna do in the future
- I don't like radios

The positive comments reflect an acceptance of the challenge to learn new skills that allows students to experience an activity they did not think was possible. The negative comments focus on relevance ("would never use it") and the level of difficulty as a reason not to participate.

4.10.6 WinGS Comments

Positive comments about WinGS:

- It would be neat to communicate with low earth orbiting satellites
- To see satellites are interesting
- Receiving signals from other areas of the world interests me

Negative comments about WinGS:

- I wouldn't have a radio license anyway

Positive comments again relate to interest in participating in the ground station. The negative comment is a reflection of relevance on student participation.

4.10.7 MSAC Comments

Positive comments about MSAC:

- It would be cool to launch rockets, and balloons in the air
- I would have to try that out and see what I learn
- This is something I'd like to do (I work in the summer)
- Cool: space stuff just has always fascinated me
- Great opportunity
- Now that seems interesting. I would like to experience launching a rocket.
- I like dealing with and using rockets

Negative comments about MSAC:

- Don't really want to spend my summer there
- Science I like, but not this
- I don't think science/space camps are fun for me
- (No) because I have my summer planned
- (No) because I have plans in the summer with my family
- I don't want to spend the summer learning about space
- I have better things to do in July
- I don't like lectures

The positive comments emphasize the hands on components (building and launching rockets) and the opportunity to try something new (rocketry). The negative comments indicate a lack of desire to commit one's personal time to an activity. Many of the negative comments made by student about the WCP Pillars reflect lack of personal efficacy. In the questionnaire students were provided with a description of the pillars asked if they thought it was interesting enough to consider participating. Cervone (2002) describes that students "actively weigh the relation between their perceived skills and the demands of the tasks when thinking about their capabilities for performance" (p.32). Lack of self-efficacy is demonstrated by the following comments:

- "I choose no because anything too technical is to confusing for me."
- "No – everything gets more complicated/complex as you start to know more about it."
- "It seems it would be hard to work with this kind of topic."

On the other hand, students who spoke positively about the WCP activities made comments that indicate a belief in their own abilities to complete the task:

- "It would be cool to operate the radio tracking equipment."
- "Science and hands-on-work interests me."
- "Hands on projects really interest me."

4.11 Interest in WinCube Activities

Question 38 asked *what activities in the WinCube Project sound interesting*. The list included all six pillars and additional activities offered within the WCP:

- CubeSat (picosatellite)
- BCube (high altitude balloon)
- Amateur Radio Class
- Manitoba Space Adventure Camp
- Satellite Ground Station
- Introductory Aerospace Design Course
- Industry tours
- Working with Universities

Table 4.29 ranks the responses of each group. Students were asked to check off all that applied to them.

Table 4.17: Interest in WinCube Activities

FY	FN	MY	MN
MSAC – 65%	No Answer–36%	CubeSat – 73%	No Answer – 58%
WinGS - 55% University - 55%	University – 33%	BCube – 64% MASC – 64% WinGS – 64% Industry – 64% University - 64%	University – 21%
BCube – 50%	MSAC – 25%	Radio – 55%	CubeSat – 15% Radio – 15%
IADC – 40%	Radio – 14%	IADC – 45%	WinGS – 9% Industry – 9%
Industry – 35%	CubeSat – 11%	No Answer - 9%	IADC -6% WinGS – 6% BCube – 6%
CubeSat – 30% Radio -30%	BCube – 8% IADC - 8% Industry – 8%		
No Answer - 5%			

The most popular choice of all four groups was the Working with Universities. The FY, FN and MY groups also chose MSAC as one of their top three choices. The MY group demonstrated a higher degree of interest in WCP offerings (one at 75% and 5 at 64%) compared to the other groups including the FY group that only had one choice with a percentage higher than 64% (MSAC at 65%). Comparing the results from Table 4.29 with the results from Table 4.28, the FY group showed great interest in MSAC and BCube, the MY group CubeSat, BCube and MSAC, and the MN group the CubeSat option.

4.12 Student Knowledge of the WinCube Project

In the targeted school of this research project, the WCP is offered as an extracurricular activity. Recruitment within the school was done through sharing announcements of WCP events and meetings through the schools Teacher Advisor program. The primary participants of the questionnaire were students in Geography with a teacher who had on numerous occasions, shared with his class opportunities for students to participate and become aware of the existence of the WCP. The remaining students in the sample should have heard about the WCP through their Teacher Advisor. Question 31: *Have you ever heard of the WinCube Project at your school* will attempt to gauge student awareness of the WCP at the school. Table 4.30 shows the results for question 31.

Table 4.18: Student Awareness of WinCube at School

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	9	45%	5	14%	4	36%	7	21%
No	11	55%	30	83%	7	64%	26	79%
No Answer	0	0%	1	3%	0	0%	0	0%

Table 4.30 indicates that students at the targeted school were not aware of the WCP's existence (74% of the sample answered No). The two groups with the highest Yes answers were the FY (45%) and the MY (36%). The lowest answers came from the FN (14%) and the MN (21%).

It would appear that at present the recruitment strategy at the targeted school is not effective with only 26% of the student sample claiming they have heard of the WCP. Also, Students who had a more positive attitude about the WCP (FY and MY) had heard about the program previously (FY – 45%, MY – 36%). What is unclear is whether or not simple previous knowledge or exposure to the WCP activities (via an adult like the Geography teacher) develops a positive attitude toward the WCP. This survey did not explore this question.

4.13 Student Participation in the WinCube Project

Question 31: *Have you ever participated in the WinCube Project at your school* was a follow up to question 30: *Have you ever heard of the WinCube Project at your school*. Table 4.31 displays the results for question 31.

Table 4.19: Student Participation in the WinCube Project

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	0	0%	0	0%	0	0%	0	0%
No	9	45%	5	14%	4	36%	7	21%
No Answer	0	0%	0	0%	0	0%	0	0%

All of the respondents to question 31 answered No. It would seem that some work needs to be done to invite students who have shown an interest in the program (the FY and MY respondents).

4.14 Summary

The data collected from this questionnaire survey suggest that students that have a general interest already in science area are more likely to find the pillars of the WinCube Project as a potential extra-curricular activity. They also see the components of the project as relevant to their future educational and career goals and view themselves as able to "handle" the new hands-on adventures before them. The young people who interpreted the WCP components as being too difficult, not relevant to what they were planning to do in their future, lacking the time for participation, and that the project was too technical and hands-on, demonstrated a reluctance to take on the new challenges of joining any of the pillar activities. Also, female responses demonstrated a preference for biology over physics, and the males picked physics over biology at the high school level. The difference in preference for the two sciences diminishes at the university level, where interest in physics and biology becomes similar for the Yes groups.

The most striking revelation through the data was evidence that suggested that students who had not previously heard about the WCP were likely to display a disinterest in the project's activities in comparison to the students who had heard about the project. One of the key issues becomes the promotion and recruitment of students to ensure they are aware of the existence of the WCP as an extracurricular activity.

Chapter Five will analyze the results of the questionnaires and personal interviews of students who have identified themselves as WinCube Project (WCP) participants.

Chapter 5: WinCube Participants Questionnaire and Interviews Results and Discussion

5.1 Introduction

This chapter will analyze the results of the questionnaires and personal interviews of students who have identified themselves as WinCube Project (WCP) participants. This chapter will first examine the student questionnaires completed by the WCP participants, followed by a case study of the WCP students who partook in the personal interview. The questionnaires will follow the same procedure as Chapter Four in evaluating results as they relate to student interest in extra-curricular science programs as discussed in Chapter 2:

- Attitudes toward science
- Family
- Peers
- Extracurricular choices
- Interest and relevance
- Gender differences

The questionnaire analysis will be broken down into the following sections as outlined in Chapter 3 (Methodology).

- Demographics
- Present education
- Future education
- Family
- Peers
- Extracurricular activities
- Interest and relevance
- WCP participation.

Each of these areas will be reviewed individually with a discussion of the findings and how they relate to the first research question of this project:

1. What factors influence student initial participation in the WCP?

Later in this chapter, the remaining three research questions will be addressed in the case studies later in this chapter.

2. What factors influence student ongoing participation in the WCP?
3. What influences does student participation in the WCP on future career aspirations?
4. To what degree do participants of the WCP believe the fundamental goals of the WCP have been achieved?

5.2 Demographics

There were five respondents that had indicated they took part in the WCP. All five completed the questionnaire, and three participated in the individual interview. The three who completed the interviews will be given the pseudonyms: Pam, Ann, and Ken. The *questionnaire only* respondents will be called Dat1 and Dat2. The following are the demographics of the five participants:

Table 5.1: Demographics

	Pam	Ann	Ken	Dat1	Dat2
Gender	Female	Female	Male	Female	Male
Age	17	17	18	17	16
Present Grade	12	12	12	12	9

Pam, Ann and Ken have been involved in the WCP in varying capacities. Dat1 and Dat2 joined the WCP this year through their involvement in the BCube at the school.

5.3 Present Education

The courses the WCP students completed are in Table 5.2.

Table 5.2: WinCube Participants' Present Education

	Pam	Ann	Ken	Dat1	Dat2
Grade 9 Math	X	X	X	X	X
Grade 9 Science	X	X	X	X	
Grade 10 Science	X	X	X	X	
Grade 10 Consumer					
Grade 11 Consumer		X			
Grade 12 Consumer		X			
Grade 10 Pre-Calculus	X	X	X	X	
Grade 11 Pre-Calculus	X		X	X	
Grade 12 Pre-Calculus	X		X	X	
Grade 11 Biology	X	X			
Grade 12 Biology	X	X	X	X	
Grade 11 Chemistry	X		X	X	
Grade 12 Chemistry	X		X	X	
Grade 11 Physics	X		X	X	
Grade 12 Physics			X	X	
Grade 11 Computer Science				X	
Grade 12 Computer Science				X	

The results of Table 5.2 indicate that the older participants have taken at least one science course past the mandatory grade 10 Science credit. Their experience is varied between taking Chemistry, Physics, Biology, and Computer Science. The results displayed in table 5.2 are inconclusive. Pam, Ann, and Dat1 have all taken science courses beyond grade 10, what they registered for is some what varied. For example, Ann did not take or complete any grade 11 on 12 physics. Ann also registered for consumer math (grade 11 and 12). As discussed in Section 4.5.1 course selection have been associated with positive attitudes toward a particular field of study based on optional science course selection. An aerospace extracurricular activity like the WCP would therefore assume participants would choose pre-calculus math and physics. As what the case in section 4.5.1, grade 10 students from the yes group and the WCP respondents do not clearly indicate this.

Table 5.2 indicates two of the female participants preferring biology over physics (Pam and Ann). This preference by females to chose biology over physics has been reported by numerous authors (Baram-Tsabari & Yarden, 2008; Farenga & Joyce, 1999; Jones et al., 2000). Ken indicated his preference for physics and chemistry over biology by the number of courses completed in each field.

5.3.1 Student Perception of Space Education

Students were asked their perceptions on the importance given to space and space-related topics in early/middle and high school levels. The results are found in Table 5.3.

Table 5.3: WinCube Participants' Perception of Space and Space-Related Topics

Early/Middle Years	Pam	Ann	Ken	Dat1	Dat2
A lot					
Some					X
A little	X	X	X	X	
Nothing					
No Answer					
High School					
A lot					
Some			X		X
A little	X	X		X	
Nothing					

Table 5.3 indicates that students who have actively participate in an aerospace program feel that the level of importance given to space-related education varies between some and a little. In Chapter four (section 4.4.1) most of the grade 10 students sampled indicated an overwhelming answer of "some" to "little" for their perceived level of importance to space education in school. Although both WCP participants and non-participants had similar views this does indicate an issue around space-related topic exposure in school.

5.4 Future Education

The following sections of future education will be varied compared to Chapter 4 because four out of the five respondents in this chapter will be graduating at the end of the school year in contrast with the previous grade 10 questionnaire respondents.

5.4.1 Future High School Courses

Of the WCP participants, only Dat2 will be returning to high school in the fall. The remainder will be graduating this year. Dat2 has indicated that he will be taking the following courses:

- Grade 9 and 10 Science
- Pre-Calculus 10/11/12
- Biology 11/12
- Chemistry 11/12
- Physics 11/12

Dat2's future course choices show he has a varied scientific background similar to the other WCP participant's courses in Table 5.2.

5.4.2 Post-Secondary Decisions

All five students have indicated they will be going to university after graduating. Specific decisions made by the students can be found in Table 5.4.

Table 5.4: WinCube Participants Post-Secondary Decisions

	Pam	Ann	Ken	Dat1	Dat2
Field of Study	Medical Rehab/ Pharmacy	Social Work	No Answer	Business/ Computer Science	Medicine
Courses to be taken					
Physics			X		X
Computer Science				X	
Engineering	X				
Astronomy					
Math	X		X		X
Biology	X	X	X		X
Chemistry	X		X		X
Career after University	Pharmacy	Social Worker	Unsure Genetic Engineer	Finance/ Software Engineer	Doctor

Table 5.4 indicates that all students will be going to university and be taking some science courses. In Section 4.5.2, the grade 10's indicated a greater tendency for university enrollment upon graduation. This result is also evident here where all five WCP participants have pointed to a similar intent. It is interesting to note that the students are all choosing careers that are not directly related to the aerospace field.

5.5 Family

The next sections will look at the family influences on student attitudes toward science.

5.5.1 Family University/College Degrees

Table 5.5 displays the university or college background of family members of the WCP participants. Each participant has indicated that at least one member of their family is a university/college graduate, each within the Science or Math field of study.

Table 5.5: University/College Degrees at Home

	Pam	Ann	Ken	Dat1	Dat2
Mother	Unknown	Economics		Accounting	Education Medicine
Father	Engineering		Biology	Accounting	Aircraft Engineer
Brother					Medicine
Brother					Business

5.5.2 Homework Help

The WCP students were asked if they received help at home with their science homework and all responded no.

5.5.3 Space-Related Media

The WCP participants were asked a series of questions that inquire how often the use various space-related sources that include television, printed material, internet, and movies. A follow up question looked at whether family members accessed those sources in relation to space-related topics. Table 5.6 displays the results for space-related television and those who watch it in the home.

Table 5.6: Space-Related Television

	Pam	Ann	Ken	Dat1	Dat2
Frequency Student Watch					
Always					
Frequently		X	X		
Seldom	X				X
Never				X	
Family Members Watch					
Yes			X		X
No	X	X		X	

The following are comments made by the WCP students with respect to TV space-related shows:

Pam: Watches documentaries on Discovery Channel

Ann: Watches "if something is on and looks interesting I will"

Ken: Watches Daily Planet and other shows. Both Parents watch "random shows and documentaries on discovery channel/others"

Dat1: Does not watch – "Boring/no good ones"

Dat2: He and his father watch National Geographic

The WCP students display various interests in watching space-related television programs. Parental viewing is split between family members watching or not watching space related programs. Table 5.7 displays the results for the accessing of space-related print media at home.

Table 5.7: Space-Related Print Media

	Pam	Ann	Ken	Dat1	Dat2
Frequency Student Watch					
Always					
Frequently			X		
Seldom	X	X			
Never				X	X
Family Members Watch					
Yes	X		X		
No		X		X	X

Comments made by the WCP students in regards to the use of print media for space-related topics are as follows:

Pam: reads newspapers and magazines. She cites both parents read newspapers

Ann: will read scientific articles "if I see something interesting I do."

Ken: accesses "old omni magazines or popular science from library – BBC News on scie/tech". His father accesses "BBC as well".

Dat1: never reads space-related print media because its "boring"

Dat2: never reads space-related print media because "I currently don't have any scientific printed press".

The responses to the use of printed material are mixed. There is a general interest in space-related topics displayed by some students (Ken, Pam, and Ann) with some parental displays of positive attitudes toward science (Pam and Ken). Dat1 does not display positive attitudes toward space based on the comment that it is "boring".

WCP student and family use of the internet for space-related information is listed in Table 5.8.

Table 5.8: Space-Related Internet Use

	Pam	Ann	Ken	Dat1	Dat2
Frequency Student Access the Internet					
Always					
Frequently			X		
Seldom					X
Never	X	X		X	
Family Members Use					
Yes					
No	X	X	X	X	X

The following are comments made by the WCP students with regards to space-related internet use at home:

> Pam: "never thought of it" in regards to personally accessing space-related material on the internet
>
> Ann: "I don't go looking unless there is something in the news"
>
> Dat1: "not in my interest"

WCP students were asked if they participated in any science related activities outside of the home with their families. Pam, Dat1, and Dat2 all said that they did not participate in any family activities. Ann and Ken said they did, and included the following comments:

> Ann: "museum, planetarium"
>
> Ken: "star watching at birds-hill park; cant remember all"

There is mixed experience of family participation in science excursions in and out of home.

The final question relating to home life is students watching science movies. Pam, Ann, Dat1 and Dat2 all said 'seldom' and, Ken said he 'frequently' did. There were no comments made by the students related to this question. In general, positive attitudes toward science were not found in the case of homework, print media, the internet, movies and activities outside of home. The exception to the WCP group was Ken who appears to access these activities (as well as his parents) more than the others from the group. The general WCP results however agree with those found in Chapter four (Section 4.6). The WCP group also showed a positive relationship of family members having university/ college degrees.

5.5.4 Peers

The WCP students were asked to list their peer's three most favorite classes and three least favorite subjects in high school. Table 5.9 has the results.

Table 5.9: Perceived Peer Favorite and Least Favorite High School Subjects

	Pam	Ann	Ken	Dat1	Dat2
Peer Favorite Subjects					
1	English Comp	English	Computer Media	Computer Science	Phys-ed
2	English Technical	Gym	Creative Writing	English	Math
3	Pre-Calculus	Cooking	English	World Issues	English
Peer Least Favorite					
1	Chemistry	Math	Physics	Gym	Electronics
2	Physics	Science	Chemistry	Pre-Calculus Consumer	Science
3	Band	Social Studies	Biology	Biology	Phys-ed

Students responded that the science/math field of study appeared outside their peer's interest for their favorite school courses. They stated that their friends also put science and math in their least favorite list category. According to Simpson and Troost (1982) "best friends and significant others who like or dislike science may be strong influences on students' attitudes toward science" (P. 769). That would mean that WCP participants completing the questionnaire should have many of the sciences as their peer's favorite subjects. This did not occur. In fact the WCP students listed their peer's least favorite subject as science. Similar results occurred for the grade 10 questionnaire (see section 4.7).

5.5.5 Extracurricular Activities

Table 5.10 lists the extracurricular activities WCP students have participated in and out of school. The results are categorized using Eccles and Barber's (1999) classification system of extracurricular activities as discussed in Chapter 2.

- **Prosocial activities** – attending church and/or participating in volunteer and community service type activities
- **Performance activities** – participating in school band, drama, and/or dance
- **Team sports** – participating in one or more school teams
- **School involvement** – participating in student government, pep club, and/or cheerleading
- **Academic clubs** – participating in debate, foreign language, math or chess clubs, science fair, or tutoring in academic subjects

(Eccles & Barber, 1999, p. 14)

Table 5.10: Extracurricular Activities

	Pam	Ann	Ken	Dat1	Dat2
In School					
Sport	Basketball		Badminton		
			Weight room		
Performance	Band				
	Choir				
School	Unity Group		Library Asst.	Peer Tutoring	
	Peer Tutoring			Scholarship	
	Student Council				
	Asian Heritage				
	SWAT				
	Grad				
Academic	WinCube	WinCube	WinCube	WinCube	WinCube
		University classes	University classes		
Out of School					
Prosocial	Volunteering	Volunteering	Volunteering	Volunteering	
Performance	Dance				
Sport		Boxing			

Most of the WCP participants have been involved with extra-curricular activities in and out of school. Ann and Ken both have taken university classes that are offered by the University of Winnipeg through the school division. In Chapter 4 there was no mention of students participating in university classes. Eligibility to take the university classes within the school division is based on completion of one grade 12 course, which is not possible for grade 10 students. In section 4.8 of Chapter four, the majority of grade 10 students said they were involved in at least one extracurricular activity. In that section of conclusion was drawn that perhaps involvement in other activities may prevent students from joining the WCP because of the time constraints. Table 5.10 however indicates that students can be involved in other activities (including university classes) and still be involved in the WCP. It would seem commitment is an important factor remaining with the WCP.

5.5.6 Interest and Relevance

To gain insight into what WCP students find interesting, they were asked to rank their favorite and least favorite subjects in high school. Table 5.11 lists their choices.

Table 5.11: WinCube Participants' Favorite and Least Favorite High School Subjects

	Pam	Ann	Ken	Dat1	Dat2
Favorite Subjects					
1	Pre-Calculus	English	Biology	Computer Sc.	Biology
2	English Comp	World Issues	Chemistry	Pre-Calculus	Math
3	Chemistry 30S	Electronics	Physics	English	Media
Least Favorite					
1	Physics	Math	French	Gym	Skills
2	English Comp	Science		History	English
3	Chemistry 40S	Geography		Geography	Phys-ed

Table 5.11 results indicate a slight preference for the science and math subjects. However, there is no clear indication of student predisposition to prefer all science/math subjects as their favorite. Simpkins, Davis-Keen and Eccles (2006) identify student enrollment in math and science courses as having a strong association with their own interests and beliefs that these subjects are important. Ann indicated that Math and Science were her least favorite subjects, suggesting that subjects were not important to her. However Ann participates in the WCP for the entire three years. It would appear that something else was keeping her and others (Pam and Dat1) interested in the WCP.

Pam's said that she liked grade 11 Chemistry and then disliked grade 12 Chemistry, reflects an ability to express her self and change her mind regarding courses to take. Simpkims, Davis-Keen and Eccles (2006) found that students "who earn good grades in Math and Science are more likely to participate in after school activities and continue with course work in these areas" (p. 80). Pam recognized on her own change in attitude towards Chemistry in grade 11 and her apparent choice not to take grade 12 Physics (table 5.2). Even though her attitudes indicate a change towards Chemistry and Physics, she remained with the WCP. There are those students who enjoy all subjects such as Ken who comment on his least favorite subjects stating "hard to say that I dislike any."

Given that the WCP is an aerospace activity, students were asked to list their three favorite space related topics. Table 5.12 provides the results.

Table 5.12: WinCube Students' Favorite Space Topics

	Pam	Ann	Ken	Dat1	Dat2
Favorite Subjects					
1	X	Stars	Rocketry	Extraterrestrial	Astronomy
2	X	Planets	Planets	Time Travel	Science
3	X	Shuttle	Exploration	Black Holes	X

The students that responded indicated an interest in Astronomy based topics (stars, planets, black holes) which are not typically covered in WCP offerings. The technical areas such as rocketry and exploration are closer to the WCP focus. In Section 4.9 (Table 4.27) grade 10 students indicated that their favorite space related topics included Astronomy and Planetary Geology. It would appear that the list of interesting topics and the WCP offerings (Satellites, Rocketry, and Mission Deployment) are inconsistent in objectives. The grade 10 student may in turn decide not to participate in the WCP because of this. However, the WCP students responded in a similar manner identifying astronomy as favorite subject. This suggest that a student choice of favorite space topics does not preclude them from participating in an extracurricular activity with emphasis on aerospace. This was demonstrated by the WCP response and participation in the WCP

5.6 Involvement in the WinCube Project

On the questionnaire, students were to indicate whether they participated in WCP activities. All five did to varying degrees, but on the questionnaire, Dat2 indicated he did not and his responses to questions answered by the grade 10 target group will be discussed at the end of this section.

The four remaining WCP students were asked in question 39: *Please indicate what activities you have participated in regards to the WinCube Project.* There responses are found in Table 5.13.

Table 5.13: WinCube Activities Participated In

	Pam	Ann	Ken	Dat1
CubeSat	X	X		
BCube Launch 2008	X	X	X	
BCube Launch 2007		X	X	
Radio Certification 06/07	X	X	X	
Radio Certification 07/08				
MSAC 2006		X		
MSAC 2007	X	X	X	
WinGS	X		X	
IADC 07/08		X	X	
Elec. Workshop 2006	X	X	X	
Engineering Presentation 2008		X	X	
Engineering Tour 2008	X	X	X	X

Three of the four students in Table 5.12 have been involved in numerous WCP activities and have also completed they personal interview for this project. Their insight into the WCP will provide some good feedback about the program.

Each of the four in Table 5.12 were also asked a series of questions in regards to upcoming WCP activities. There responses follow.

Q. 40: *Will you be participating in any of the following upcoming events?* (Check all that apply)

a. Manitoba Space Adventure Camp July 2009

Pam: No
Comment: I will be very busy this summer and may be out of town in July

Ann: No
Comments: was not invited

Ken: No
Comments: work conflicts

Dat1: No
Comments: Not in my interest

b. BCube launch – June 2009

Pam: No
Comments: I have an exam the day of the launch

Ann: Yes
Comments: Because it is my baby

Ken: Yes
Comments: Helped with planning

Dat1: Yes

c. BCube launch – Winnipeg Amateur Radio Club – June 30, 2009

Pam: No
Comments: I have an event to go to that day

Ann: Yes
Comments: I am part of my group and its what you do as a member

Ken: Not sure

Dat1: No

Most of the four students were interested in participating in the upcoming BCube launches because they had been involved in the planning. This is unique considering they are graduation at the end of the year and still remain interested in committed to the WCP. It should also be pointed out that the MSAC is specifically targeted for students presently in grades 9 to 11; four of the students in the interview group were graduating this year. The reason for this rule is the WCP uses the MSAC as an introduction to all of the other activities offered through the year. Since these students will be graduating, MSAC is not recommended. However, students that have participated in WCP and have graduated are encouraged to maintain their involvement as a leader in the program.

On Dat2's questionnaire he answered No to question 30: *Have you ever heard of the WinCube Project at your school.* He was instructed on the questionnaire to proceed to questions 32 to 38. The questions and Dat2's responses follow.

32. *Based on the description of the CubeSat small satellite project, would you ever consider joining this component of the WinCube Project?*
    Answer: Yes
    Comments: Because I could learn, experience

33. *Based on the description of the BCube, would you ever consider joining this component of the WinCube Project?*
    Answer: Yes
    Comments: It looks cool enough

34. *Based on the description of the Amateur Radio Course (ARC), would you ever consider joining this component of the WinCube Project?*
    Answer: No
    Comments: I have no idea with radio tracking

35. *Based on the description of the WinCube Ground Station (WinGS), would you ever consider joining this component of the WinCube Project?*
    Answer: Yes

Comments: Communicating with International Space Station would be a nice idea

36. *Based on the description of the Manitoba Space Adventure Camp (MSAC), would you ever consider joining this component of the WinCube Project?*
    Answer: No
    Comments: Don't have the time.

37. *Based on the above description of WinCube, do you find the overall project appealing?*
    Answer: Yes
    Comments: (no comment recorded)

Question 38 asked: *What activities in the WinCube Project sound interesting,* Dat2 chose BCube and working with universities. The questionnaire terminates after question 38 for Dat2 so there is no indication of what upcoming activities he would have been interested in. Dat2 has indicated he is interested in numerous components of the WCP, but he does not have time in the summer to attend MSAC, he lacks an understanding of amateur radio. Dat2's responses are similar to those of the males yes group that partook in the questionnaire only (see section 4.10)

5.7 Individual Interview

The next sections will review responses to the individual interview with Pam, Ann and Ken. They will be done according to the four research questions of this project.

5.8 Factors Influencing Initial Participation in WinCube

The first four questions of the individual interview address factors influencing initial participation in the WCP and involve research question 1: (What factors influence student initial participation in the WCP?) Each question will be presented, a brief description of student comments, followed by the researcher's views.

Question 1: *How did you find out about the WinCube Project?*

Pam: Through her grade 9 math/science teacher.

Ann: Through one of her teachers

Ken: "Stumbled upon a meeting. Didn't hear any formal recruitment or anything"

Researchers Comments:

At the time that Pam, Ann and Ken joined WinCube, it was the first year of the program. In the case of Pam, her grade 9 math/science teacher recruited students extensively out of his grade 9 classes. With regards to self-efficacy, verbal persuasion played a role in Pam and Ann joining the WCP. Zimmerman (2000) defines verbal persuasion as a factor where "outcomes are described and not directly observed" (p.88). The teacher that spoke to Pam and Ann must have been convincing for them to try the WCP.

Question 2: *Describe the WinCube Project.*

Pam: "Students from different high schools. Collaborating ideas. Making cube satellite. Trying to decide what to do with it."

Ann: "Disorganized. Turned into just our cube. Kinda got taken away from us by the University of Manitoba. Launching a pico satellite."

Ken: "Kids get together. Discuss and learn about space related topics. Work on weather balloon payload project which leads up to a cube sat project. Learning basic principles of satellite design."

Researcher's Comments:

At the time Pam, Ann and Ken joined the WCP, the initial intention of the project was to have Manitoba high school students design and build a CubeSat with the help of the University of Manitoba's Faculty of Engineering. As outlined in Chapter 1, it was realized that high school students did not poses the technical background necessary to build a CubeSat from scratch. At that point the University of Manitoba took the lead in the design and construction of the WCP's CubeSat. The WCP Advisory Committee established a number of activities to build on the necessary skills to work with the University of Manitoba. Activities were created as needed and varied in opportunities throughout the year. It is interesting to review Pam and Ken's description of the WCP. They describe it as more of a social activity (kids get together) in a supportive (collaborating ideas) and nurturing ("discuss and learn") environment. In Chapter four a number of students commented about not having the skills or abilities perceived necessary to join the WCP. The actual experience seems to be different from the initial perception of the program.

Question 3: *Why did you join the WinCube Project?*

> Pam: "really liked science in grade 9. Entered Manitoba Science Exposition. Teacher realized that I enjoyed science and thought that this would be a good idea for me."
>
> Ann: "Because I was asked. Sounded interesting at the time. Astronomy was interesting to me at the time."
>
> Ken: "Wanted something to do during lunches. Not really committed to other groups. This seemed interesting."

Researcher's Comments:

Self-efficacy seems to have played a key role in Pam's decision to join the WCP. Cervone (2000) makes reference to a person weighing this relation between "their perceived skill and the demands of the tasks when thinking about their capabilities for performance". (p.32) Pam describes her prior experience to joining the WCP that seems to have given her the self-confidence to join. In Section 4.10 a similar pattern emerges. Those students that spoke positively about the WCP pillars did so with comments like;

"Hands on projects really interest me" and "it would be awesome to communicate with satellites." These grade 10 comments reflect a positive attitude toward the subject and belief in their ability to succeed in areas of study.

It seems apparent from Pam and Ann's comments that an adult encouraging students to become involved in certain extracurricular activities is needed. It also helps when an adult nurtures a student's self-efficacy to join an academic club like the WCP especially if they may not have thought of it themselves.

Question 4: *What were your expectations of the WinCube Project?*

> Pam: "Fun, different experience. Never worked with space stuff before. Help me decide on what to do with my career. Was helpful in all of these things."
>
> Ann: "Didn't have any. Unsure of what it was going to be."
>
> Ken: "No real idea about what it was. Thought it was a lot about rockets – what I overheard from the first meeting before I joined. Didn't know about the building of payloads that were involved"

Researcher's Comments:

Pam's comments about "never worked on space stuff before" indicate a generality to her self-efficacy. Zimmerman (2000) defines generality in the area of self-efficacy to "pertain to the transferability of self-efficacy beliefs across activities." (p.83). It would seem plausible to apply the generality of self-efficacy to apply to Ann and Ken as well since neither fully understood what they were becoming involved with.

Going back to question 3 of the interview, it seems critical that students are encouraged to join extracurricular activities like the WCP. Ann for example identified the fact that she didn't have any idea what it was going to be like. The adult encouraging her to go and find out about the project developed into a three year commitment. In the case of Pam, it seems that her grade 9 science/math teacher would have offered some advice in regards to science careers. The first step for an extracurricular program is to recruit participants; the next is to provide activities that will keep them engaged in the program.

5.9 Factors Influencing Initial Participation in WinCube

This section will look at research question 2: What factors influence student ongoing participation in the WCP? Questions 5-9 of the individual interview will address this.

> Question 5: *What do (did) you enjoy about the WinCube Project?*
>
> Pam: "Meeting students from different schools. Not an everyday thing that high school students do. Good tours (museums, workspaces). Get new experiences all of the time."
>
> Ann: "we are free to do something that we normally wouldn't be able to do. Gives us a chance to do new things that others may not get to. Meet new people that we wouldn't have met before. Make contacts that can help further my career."
>
> Ken: "All of the hands on stuff. Good to get out of the school and apply what we make. When we make something and send it up it's pretty cool."

Researcher's Remarks:

Pam and Ann enjoyed the opportunity to meet with students from other high schools in Manitoba. This was a key aspect of the WCP to encourage collegiality among its participants. The peer group development within the WCP either within the school or between participating high schools could become its own unique group. "Ones co-participants becomes one's peer crowd, and such peer crowds often develop an activity based culture providing adolescents with the opportunity to identify with a group having shared sends of style" (Eccles & Barber, 1999, p.29). Through interschool activities "one's friends will be drawn from among the other participants (Eccles and Barber, 1999.

p.31.). There is also an interaction between students and adults in the WCP as Ann describes: "Maybe contacts that can help further my career." The WCP provides the opportunity "to get to know other peers and adults through personal bonding and in vital trust and commitment" (Feldman & Matjasko, 2005, p.162)

The WCP is constantly looking for unique opportunities for participants to become involved with and it seems that this has been effective. Students are encouraged to take ownership on the work that they do (example BCube construction) and it appears the students enjoy that opportunity. Pam's comment about "new experiences" keeps students like her interested in the WCP. But this attention "can be sustained as long as we can continue to find interest patterns in the stimulus" (Simon, 2001, p.6). Of the context being presented Ken appreciated being able to "apply what we make." Yager (2004) states "real world experiences with science are remembered more then experiences with the science of textbooks in classrooms and laboratories." (p. 413)

Question 6: *What do (did) you not enjoy about the WinCube Project?*

> Pam: "Technical stuff was kinda boring (computer). Enjoyed the hands on stuff more. If they explained more about the computer aspect instead of just hearing what we needed to – if we knew why it might have been better."
>
> Ann: "Disorganization. Things are told to us a little bit too late. It would have been nice to have advance notice on a few things. Communication – it was hard for us as students to be able to communicate about what needed to be done."
>
> Ken: "If there were dull or slow meetings some of the stuff related to amateur radio. Early morning amateur radio lessons weren't interesting. Hard to get up on Saturday."

Researcher's Remarks:

Pam, Ann and Ken were all committed to the WCP as demonstrated by their comments ("Didn't want to leave something I started, I need to be there, determined to stick with it"). These comments represent self-efficacy students who tried to "participate more readily, work harder, persist longer (Zimmerman 2000, p. 86)

Both Pam and Ken comment that certain aspects of the WCP were "Boring" and there "dull or slow meetings". Simon (2001) points out that "our attention can be sustained as long as we can continue to find interesting patterns in the stimulus" (p.6) As with any science or Math program, there are theoretical components that must be presented. The WCP included computer programming and amateur radio. The WCP continues to re-evaluate its program delivery to streamline theory and deliver more hands on programming. However Pam and Ken's comments brings up another point. In the questionnaire, grade 10' indicated that they would not participate in the WCP because it was boring. But students like Pam and Ken chose to remain even though aspects of the project were boring. There must be other reasons students become and remain involved in the WCP.

Question 7: *Why did you remain involved with the WinCube Project?*

Pam: "Enjoyed it. Wanted to build on the experience. Didn't want to leave something I started."

Ann: "It's my baby. Spent a lot of years working on it. Took extra courses. Go up at 7 on Saturdays to participate. Because I am project lead I need to be there."

Ken: "Had friends in it. Good People to work with. Interesting, fun to build stuff. Presentations were interesting."

Question 8: *Did you consider withdrawing from the project? If so, why?*

Pam: "No, determined to stick with it."

Ann: "Never."

Ken: "Not really. Slow pace at some times anyways. Not strenuous pressures associated with it."

Researchers Comments

The comments relating to question 7 focus on two major concepts: Commitment and peers. The influence of peers when the WCP maybe a result of the emerging group identity:

> To the extent that one spends a lot of time in these activity settings with the other participants, it is likely that one's friends will be drawn from among the other participants. It is also likely that the collective behaviors of the peer group will influence the behaviors of each member.
>
> (Eccles & Barber, 1999, p. 31)

Within this new group,

...peers may positively reinforce conventional behaviors, may exert pressure toward school involvement, and may model positive affect and commitment to academic endeavours.

(Fredricks & Eccles, 2005, p. 517)

This may imply that the group dynamic was a big component to maintain student involvement.

Question 9: *Would you recommend the WinCube Project to other high school students?*

a. Why? Why not?

b. If yes, who?

Pam:

Why? Why not?

"Yes I would recommend it because it is something new to try. Good to finish by saying that you were involved in a different program. Gives a lot of opportunities."

If yes, who?

"Students who enjoy science and astronomy. Anyone interested in space stuff. Good for people entering engineering."

Ann:

Why? Why not?

"Of course. Great way to make contacts. Get interested and excited about something that you have accomplished. Able to say that you got a chance to launch high altitude balloons. Fun, not just work. Learning outside of the classroom."

If yes, who?
"Starting in grade 9 or 10. Good to have a couple of years to get established. Some new members this year didn't have the experience to lead. Team building would have been good to help us communicate and be comfortable working with the group. Small group work."

Ken:
Why? Why not?
"Yes. Good because of hands on work. Presentations at universities were good. Good science topic."

If yes, who?
"Anyone interested in science. Enter anytime in high school, but the earlier the better."

Researcher's Remarks:

The present participants of the WCP recognize a need for students to become involved early on in their high school career. This world provide opportunities for students to have "a couple of years to get established" because "this year didn't have the experience to lead"(Ann). The WCP Advisory Committee's approach is to recruit in grades 9 and 10 to help develop the skills of participants.

It is apparent from a number of students in the grade 10 survey (section 4.10 that their sense of domain-specific personal efficacy will be low because of a lack of confidence in their intellectual abilities and the estimated level of difficulty they perceive they will encounter if they join the WCP (Eccles, 1994). However, if grade 9 and 10 students can be shown they have the necessary entry level skills and they will be able to develop their skills to fully participate in the WCP.

All three WCP participants refer to various "opportunities" where "hands-on", would get students "interested and excited about something that they have accomplished." These are the reflections of why student should join the WCP and will need to be shared in the future with possible prospects for the WCP.

Question 15: *Has the WinCube Project met your expectations?*

Pam: "Yes from my initial expectations. Students could have had more to say in the project."

Ann: "Yes and no. BCube launch definitely met because we reached our goals, launched the payload. WinCube itself we haven't seen anything this year. Didn't go to all meetings that we thought we would."

Ken: "Yes."

Researcher's Remarks:

It appears from the general answer of the "yes" that the WCP has met students' expectations. Although initial expectations of Pam did not indicate her expectation of student input in to the project (question 2 of the interview) she felt a need for this. Ann's comments reflect a positive point (BCube Launch) and a sense of frustration that the other activities relating to WCP did not transpire as planned. This sense of frustration could impede maintaining student interest in the WCP and be a result of the high attrition rate felt by the program.

The next section will look at student feedback in regards to the WCP Advisory Committees five fundamental goals of the WCP.

5.10 Achievement of the WinCube Project's Fundamental Goals

In this section a review will be carried out on student responses to whether or not the WCP's five fundamental goals have been accomplished. The goals are:

- Provide authentic science and innovative research learning opportunities
- Application of high level science, math and technology
- Enrichment for students to develop further interest in science and engineering

- Develop collaborative opportunities with post secondary institutions and/or industry on a local, national and international level
- Raise profile of aerospace in schools and community

(Cieszecki et. al., 2008)

The initial statement given to WCP participants for questions 10-14 is as follows:

> *The WinCube Project has five fundamental goals. Please comment on whether or not the WinCube Project has met those goals during your participation.*

Each individual question as it relates to the goals of the WCP and the responses follow.

> Question 10: *Goal 1- Provide authentic science and innovative learning opportunities.*
>
> Pam: "Could have more of. They teach us and we just do it, but it would be better if we could research stuff on our own."
>
> Ann: "Yes. Science – had to deal with atmospheric pressure. Research for me was good but overall not everyone did research."
>
> Ken: "Yes. Got to actually go our and apply stuff and trouble shooting. Get to apply the scientific method. Trial and error when we design and schedule our own things. Got to actually do research."

Researcher's Comments:

In Chapter One (section 1.5) a number of curriculum links were established with Pan-Canadian (CMEC, 1997). The four General Learning Outcomes that involve skills are presented here:

- Initiating and Planning
- Performing and Recording
- Analysing and Interpreting
- Communication and Teamwork

(CMEC, 1997, p. 195)

Under 'Initiating and Planning" students are encouraged to "ask questions" and "plan investigations of questions, ideas, and problems and issues" (CMEC, 1997, p. 195). This was accomplished according to Ann (atmosphere, research) and Ken (applying scientific method, trial and error, actually do research). Pam counters the research by stating "it would be better if we could research stuff on our own." Perhaps in Pam's case it relates to her own level of involvement. It appears that goal number one is being achieved.

Question 11: *Goal 2: Application of high level science, math, and technology.*

Pam: "High level technology and science, but not as much high level math."

Ann: "Technology definitely. We never did any of the math ourselves. Everything was mapped out. Science could be applied. Technology was the main thing."

Ken: "Science – definitely achieved. Math – not a component for us to do. Technology – lots because it all leads up to the CubeSat. Technology was the most applied in the project."

Researcher's Comments:

All three students have agreed that they had the opportunity to apply technology and science. The WCP Advisory Committee may need to review inclusion of math as one of their subject application areas. It is an important aspect for goal one and two to deliver on its promises if students are joining the WCP based on these goal statements.

Question 12: *Goal 3 – Enrichment for students to develop further interest in sciences and engineering.*

Pam: "Yes."

Ann: "Yes definitely. Always trying new things."

Ken: "Yes."

Researcher's Remarks:

It would appear from the positive comments that goal three is being accomplished. It seems that there have been sufficient opportunities for students to experience new things (Ann). Unfortunately there is not enough commentary by the participants to make any further remarks.

Question 13: *Goal 4 – Develop collaborative opportunities with post secondary institutions and/or industry on a local, national and international level.*

Pam: "Yes because we got to work with U of M and aerospace. Didn't really get to work with other countries."

Ann: "No. University took over our thing and pushed us out. University did not keep their promises. We knew more about the project than they did. Able to make contacts with different airspace places in Winnipeg."

Ken: "Yes. All levels. Got to go to university constantly, talk to schools and universities in North Dakota. National components when we talk to Canadian Space Industry. Industry – went to space camps where we got to tour facilities and how what we did applied to their jobs."

Researcher's Remarks:

As presented in Chapter One, students had numerous opportunities to visit with universities (University of Manitoba, University of North Dakota) and local aerospace industry (Magellan Aerospace). All three respondents recognized these opportunities. Of course these collaborative efforts were an opportunity to expose students to outcomes related to science, technology, engineering and mathematics (STEM); science, technology, and society (STS); and science, technology, society and the environment (STSE) (see Chapter One).

Question 14: Goal 5 – *Raise profile of aerospace in schools and community.*

Pam: "Not advertised a lot here at Maples. Need to tell people what it is all about and who would be interested. Don't really know what it is. Intimidating to new students. Students are hesitant to enter because of the way it sounds. Could sound more exciting."

Ann: "Definitely made itself aware. Evident around Winnipeg. More aware of satellites and programs in the city. A lot of them were top secret places."

Ken: "Yes."

Researcher's Remarks:

Ann's comments reflect her experiences as a WCP participant. Her comments indicate that STEM, STS, and STSE goals are being accomplished by the WCP for its participants. Pam's reflection involves WCP exposure to students at the targeted school. She cites the fact that because students are not aware of the WCP and its activities, when they are approached to join, they don't feel they have the skill or interest to join (a self-efficacy issue). Suggestions by the WCP students to increase participation are presented in question 17.

Question 17: *What suggestions do you have to improve the WinCube Project?*

Pam: "Advertise more. Make it more student based. More interesting – add aspects that students would be more interested in. More grades and tens involved. Good program overall, glad they started it and glad to be a part of it."

Ann: "Everything needs to be more organized. Set meetings in advance. Sheets and forms – more standard procedure sheets." Communications between members:

- Everyone needs to be involved
- Everyone responsible for contacting everyone else
- Team needs to work together and everyone needs to know this
- Our project and our group
- Team building activities would help
- Former members like me would be willing to come back to share and help organize it.
- Would like to stay involved even after graduation high school
- Want to see this be successful
- People need to be more decisive as to whether or not they want to participate
- Everyone needs to be responsible for their individual tasks
- Disappointing to see people who didn't stick around
- To get interest built in the project, need to teach them about it from grade 9
- Help if there was more of a space focus in the science courses
- Would be nice to be exposed to more of this in the classroom
- More interest could be generated in science classrooms
- Would tie what we are doing into the classroom, or more support from the school itself would be helpful

- Amazing experience that I would do again in a heartbeat"

Ken: "More regular schedule – but hard because of so many conflicting schedules. Cut things down on Saturdays – can be hard to attend. Recruitment – need more of it. Flaw to the group – not a lot of sustainability. Need more students involved. Only a handful of students who were able to come each time."

Researcher's Comments:

Suggested improvements of the WCP by existing participants can be categorized into two areas: recruitment and program adjustments. Recruitment issues were cited by Pam in questions 14 and 17 along with Ann and Ken in question 17. Comments like 'advertise more', 'get more grades and tens involved', 'recruitment-need more of it', and 'need more students involved' all reflect and a need for more students to accomplish WCP projects.

To increase recruitment, Ann suggests the "need to teach them about it from grade 9", and provide "more of a space focus in the science courses." As stated earlier, a suggestion for students to become involved in the WCP is for participating schools to incorporate WCP activities in existing classes.

Both Ann and Ken also cite issues with retaining membership in the WCP. Ken points out that there is a "Flaw to the group – not a lot of sustainability" that may be due to an issue around WCP being often outside of the school day. Eccles and Templeton (2002) reported that community-based programs offered during regular school hours had a better attendance than after-school programs. If perhaps some of the WCP activities were provided in present classes, the impetus to continue to be involved in the WCP might exist.

Ann's comments about organizational issues is a reflection of ongoing WCP program development. In school and out of school activities must be planned well in advance. There is also a move to standardize program protocols to help with WCP expectations of student participation. The next section will focus on the effectiveness of WCP on student career choices.

5.11 WinCube Influences on Future Career Aspirations

In Chapter One, it was shown that the WCP is attempting to provide learning opportunities that expose students to various careers within the aerospace industry. The learning outcomes fall under the STEM, STS, and STSE learning outcomes. Question 16: *Has participation in the WinCube Project influenced your future career decisions or interests,* attempts to see if this is occurring.

> Pam: "Yes, it made me even more interested in science and experimenting and learning new stuff. Helped clarify."
>
> Ann: "Did before but not in the end."
>
> Ken: "Of course, because I was exposed to more. Able to show me what I wanted to do and what I don't want to do. Gave me more of a perspective of what engineering was. Now I feel more informed about engineering."

Researcher's Comments:

In the case of Pam, one of her original reasons for joining the WCP was to help her to 'decide on what to do with my career' (answer to question 4, Section 5.7). Pam's experience in the WCP helped 'clarify" what she wanted to do by 'becoming more interested in science and experimenting.' Ken also commented that he now has 'more of a perspective of what engineering was' because he was 'exposed to more' through the WCP.

If the WCP is incorporated into existing classroom activities, students may gain some insight into the potential experiences of the WCP and increase its relevance to students.

5.12 Summary

This chapter reviewed the results of the questionnaire and interview completed by the present WCP participants. These results when compared to those of grade 10 questionnaire responses displayed a number of similarities with regards to the male and female groups that indicated they found the WCP interesting. They included the following:

- Varied choices of high school courses taken (no predisposition for one course more than another)
- All intend to go to university/college with varied interest in courses
- No significant family experiences relating to space-related sources
- Participation in extracurricular activities are displayed
- At least one family member with a university/college degree at home.
- Majority of peers perceived not to have a strong interest in science or math
- Students personal interest in science and math varied
- Space education is not receiving a high level of importance in school

From the individual interview of WCP students, they felt that the five fundamental goals of the WCP were being met. They highlighted that they enjoyed the experience of participating and the opportunity to explore career opportunities related to aerospace. Areas that they felt needed improvement included:

- The need for more participants at the targeted school
- The inclusion of space topics and WCP activities in regular classrooms
- More student input into WCP activities
- Work on the retention of student participants

In the next chapter, I will review the findings of this research project, the limitations of the study, the implications of the study, make recommendations for future research, and make closing comments.

Chapter 6: Summary

6.1 Research Questions 1 – 4

The previous chapters of this theses "Student Interest in The WinCube Project: Influences on Student Participation In An Extracurricular Aerospace Program" looked at answering the following four research questions:

1 What factors influence student initial participation in the WCP?
2 What factors influence student ongoing participation in the WCP?
3 What influences does student participation in the WCP have on future career aspirations?
4 To what degree do participants of the WCP believe the fundamental goals of the WCP have been achieved?

Chapter One described the Manitoba high school aerospace program, the WinCube Project (WCP). The description included the WCP's five educational goals and its six main educational opportunities for participating students. Also presented were the WCP's educational curriculum links to the Pan-Canadian Common Framework of Science Learning Outcomes (CMEC, 1997), and the Manitoba Provincial Science Curriculums: Senior 1 Science (Manitoba Education and Training, 2000), Senior 3 Physics (Manitoba Education and Youth, 2003), and Senior 4 Physics (Manitoba Education, Citizenship and Youth, 2005).

In Chapter Two, a literature review was completed detailing student self-efficacy and student attitudes towards science as they relate to extracurricular participation. Factors identified as effecting self-efficacy and student attitudes included family, peers, student self-perception, relevance and interest. Chapter Three outlined the methodology used to answer the four Research Questions, which included the use of a student questionnaire and personal interview. The students in this study were broken up into two primary groups. The first group were students taking grade 10 core subjects at the targeted high school. These classes were identified based on the understanding that students were aware of the WCP in their school. This grade 10 group completed the questionnaire only. The second primary group of students were presently participating in the WCP. They were asked to complete the same questionnaire as the grade 10 group along with participating in a personal interview. Chapter Four reviewed the responses to the grade 10 questionnaire target group and Chapter Five the results of the questionnaire and personal interview with the WCP participant group.

Research Question 1 used the questionnaire as its information source. The grade 10 students were divided into four groups. The first grouping was based on female and male respondents. The female and male groups were further subdivided based on their response to the question: *Based on the above descriptions of the WinCube, do you find the overall project appealing* after having read brief descriptions of five of the WCP pillars. The four groups established were: female yes = FY, female no = FN, and male yes = MY, male no = MN. Of the 100 grade 10 students surveyed, 56 were female and 44 male. In the creation of the Yes/No groupings, the student breakdown was FY=20 students, FN=36, MY=11, and MN=33. Only 31% of the grade 10 sample indicated they found the overall WCP interesting. Results were recorded, analyzed, and discussed in Chapter Four.

For Research Question 1, a student questionnaire was created to try to determine possible influences that might predispose a student to participate in the WCP. The questions were created based on the Chapter 2 literature review of student self-efficacy and attitudes toward science as they related to extracurricular participation. The questionnaire had nine areas of study that included: demographics, present education, future education, family, peers, extracurricular activity participation, interest/relevance, WCP participation, and gender biases. Chapter Four reviewed the results of the grade 10 respondents and Chapter Five the WCP participants. The questionnaire was used to compare results between the primary groups to see how students that were not part of the WCP (grade 10 students) responded to questions compared with those who were involved with the WCP.

In comparing student course selections, the grade 10s did not display any major differences in preference of science courses between the two female groups and the male groups when comparing a specific course. Similar results occurred for the WCP participants. Where a noticeable difference did occur was the preference for females to study biology over physics, and the males preference to study physics over biology. The grade 10 biology numbers were FY=90%, FN=83%, MY=64%, and MN=61%. The trend is reversed for physics were more males preferred the subject than females: FY=30%, FN=19%, MY=45%, and MN=36%. These results of gender biases are similar to other research findings (Jones et al., 2000; Osborne & Collins, 2000; Farenga & Joyce, 1999). The implications of these results for females preference for studying biology may imply a desire for activities that involve high social relevance (Reid & Skryabina, 2003). Females often avoid activities that have a high mechanical or practical relevance such as physics (Reid & Skryabina, 2003). It would appear that a preference for physics is a good indicator of student involvement in a hands on activity like the WCP. However, their were two female WCP participants that preferred biology over physics. When students were asked what their favorite subjects were, the resulting data was inconclusive. Students were identifying the same subjects as their favorite and least favorite.

In evaluating post-secondary decisions, there was a greater indication among the grade 10 Yes groups to attend university (FY=75% and MY = 82%) compared to the No groups (FN=58% and MN=39%). All of the present WCP participants indicated they would attend university. At university, the grade 10 Yes groups were primarily interested in the area of science and math (FY=55%, MY=45% compared to the No group in that field of study (FN=36%, MN=12%). The results for the WCP group primarily preferred science fields of study. However, the two male WCP students did indicate they planned to study physics at university, but the females did not, instead preferring to take biology.

Students were asked to reflect on the level of importance they felt was given to space and space-related topics in their early, middle, and high school experiences. Using a Likert scale, the majority of responses were 'some' to 'a little' for the majority of grade 10s. The combined results of the 'some' to 'a little' at the early/middle (EM) and high school (HS) were:

FY:	EM=90%	HS= 75%
FN:	EM=86%	HS=81%
MY:	EM=82%	HS= 72%
MN:	EM= 66%	HS= 60%

The biggest group that indicated 'nothing' was the MN group with 33% in early/middle years and 39% at high school.

It appears that the grade 10 students sampled are not being exposed to space-related content at sufficient levels in the classroom. This leads to the results of grade 10s favorite topics about space. The primary response was related to general astronomy (stars, galaxies, etc.) and planetary geology (planets, moons, etc.) as indicated by all four groups. In reviewing their reflection of level of importance space-related topics receive in early/middle and high school, the WCP student also indicated 'a little'. Their responses to favorite space-related topics however included more aerospace related topics such as 'rocketry', 'exploration' and the 'shuttle'. Given the similar responses in regards to space-related importance in their education, both the grade 10s and WCP students indicate it was minimal at best. Where the results differ is in the knowledge background of space fields of study based on their favorite space topics. It would appear that the grade 10 students have not been exposed to sufficient levels of space topics in their regular experiences which may impact their willingness to participate in an extracurricular activity like the WCP.

The next area of interest in the questionnaire was the influences of home life on a student's decision to join the WCP. First, students were asked to identify family members that had university/college degrees in the home. The grade 10 Yes groups reported a higher percentage of at least two family members having a university or college degree (FY=45%, MY=45%) than their No counterparts (FN=19%, MN=18%). For the WCP participants, all reported of having at least one family member at home with a university or college degree.

A students interaction at home has been shown to have an impact on student attitudes toward science (Tocci & Englehard, 1991; Simpson & Oliver, 1990; Talton & Simpson, 1986; Simpson & Troost, 1982). To gain a better understanding of student exposure to space-related activities at home, the questionnaire addressed six areas: homework, television, print media, the internet, movies, and out of home family activities. In the case of receiving help with science homework at home, the majority of grade 10s indicated they did not (FY=60%, FN=75%, MY=73%, and MN=70%) and all WCP participants as well.

When asked if they watch space-related television programs at home, most of the grade 10 indicated 'seldom' to 'never'(combined scores for both choices: FY=70%, FN=86%, MY=54%, and MN=69%) with slightly better results for the WCP participants. As for family members watching space-related television, most reported no (FY = 70%, FN=58%, and MN=79%) including WCP students. The only group indicating higher family participation was the MY group at 64%.

In the case of printed media, all grade 10 groups indicated they 'seldom' to 'never' accessed this resource (combined results: FY=90%, FN=97%, MY=72%, and MN=94%). The majority of family members are also not accessing space print media (FY=60%, FN=78%, MY=82%, and MN=76%). Similar results were indicated by WCP participants.

Students use of the internet for space topics also came up with the majority of students responding 'seldom' to 'never' (combined scores: FY=95%, FN=87%, MY=72%, and MN=75%). Family members are also not using the internet for space-related activities (FY=85%, FN=92%, MY=82%, MN=85%). Again, similar results were reported for the WCP participants.

The majority of students also indicated that they did not participate in family outings related to science (FN=83%, MY=73%, and MN=88%) including the WCP participants. The exception was the FY group that reported 45% of actually participating in such activities.

When students were asked how often they went to the theatre to watch space themed movies, again the majority indicated ‘seldom’ to ‘never’ (combined scores: FY=100%, FN=100%, MY=81%, and MN=84%). The majority of WCP members indicated ‘seldom’.

Although the apparent lack of family involvement in space activities at home may provide some indication as to why students are not actively participating on a larger scale in the WCP, this may not necessarily be the case. The WCP students indicated similar levels of home involvement in space activities, yet they still participate in the WCP.

The previous few paragraphs have shown that students are not engaged in space or science related activities in their homes. Another observation is that family members are not displaying positive attitudes toward science in the areas examined by the questionnaire. Often the only time students will actively access one of the media sources is if it is needed for a school assignment. It would therefore seem that if one was to try to develop student interest in science or space related activities at home, they may need to be initiated from the school.

Peers have also been shown to influence student attitudes toward science and their participation in extracurricular activities (Fredricks & Eccles, 2005; Eccles & Barber, 1999; Simpson & Troost, 1982). When students were asked to comment on their friends favorite and least favorite school subjects, both of the grade 10 Yes groups indicated the top two peer favorite subjects as gym and math. For the No groups, their top pick for favorite was science. This contradicts much of the research which would have students who were interested in a science extracurricular activity indicating their peers preferring science as a favorite subject. The WCP students also indicated that their peers favorite subjects were primarily comprised of English and Gym. The lease favorite subjects were science and math.

Students were asked to identify what extracurricular activities they participated in or out of school. For school related activities, the majority of grade 10s were involved (FY=65%, FN=58%, MY=64%, and MN=58%). The overall average for the grade 10s at the targeted school was 60% (females = 61% and males = 59%). These results were slightly lower than those reported by Eccles and Barber (1999) at a level of 69% participation. It is interesting to note that the FY group was primarily involved with school activities such as student council, social issues groups (45%) while the MY group participated fully in performing arts activities like band and drama (100%). It would seem that the two Yes groups prefer activities that have a high social relevance (Reid and Skryabina, 2003) as opposed to high mechanical or practical relevance that is often displayed in an activity like the WCP. The WCP participants all indicated that they were involved in some extracurricular activity with the majority volunteering (prosocial activity) outside of the school. In reviewing the primary sample groups in this study, both displayed similar levels of extracurricular participation. This would indicate that involvement in other activities does not preclude one from participating in the WCP, as demonstrated by current WCP members.

When the grade 10s were asked about their interest in participating in any of the five specific WCP activities (CubeSat, BCube, Amateur Radio, Ground Station, and Manitoba Space Adventure Camp) the FY group showed the greatest interest with a range of interest of 45% to 60%. The MY groups interested ranged from 18% to 55%, the FN 6% to 14% and the MN 9% to 15%. Out of the 100 grade 10 students that completed the survey, 20 females (out of 56 females) and 11 males (out of 44 males) indicated they were interested in the WCP project. Students who did not indicate their interest in the WCP made general comments like "it's boring", "not into space" and "not interested". A number felt that the activities sounded difficult, indicating a low level of self-efficacy to the WCP offerings.

The personal interviews provided data about why students become involved with the WCP. The three students that were interviewed (they also had completed the questionnaire) were WCP participants. When asked why they joined the WCP, the most common responses was they 'heard about it from a teacher' and that it had sounded 'interesting'. One student saw it as an opportunity to explore possible career choices. Their initial understanding of the program wasn't strong, but they joined the WCP, indicating a high level of self-efficacy in the case of a high school aerospace program.

Data for Research Question 2 to 4 also came from the personal interview of present WCP participants. The first area asked what influenced students' continued participation in the WCP. Responses included the variety of learning 'opportunities' provided, the chance to try out new things, 'apply' what they learned, the opportunity to meet new people (students from other schools and adults from various aerospace sectors) and the 'hands on' experiences. Students did cite some of the 'technical' portions of the program (radio classes, meetings) as boring, and issues with the organizational planning of the WCP activities. When specifically asked why they remained with the program, students said they 'did not want to leave something' they 'started', and the 'friends' that were part of the program. When asked if they ever considered withdrawing from the program, all three said no.

Research Question 3 looked at responses from the personal interview about whether participation in the WCP had a positive effect on future career aspirations were all positive. The WCP helped them with these decisions by providing numerous learning experiences and the chance to do real science.

Research Question 4 looked at whether or not the five fundamental goals were achieved. Student responses to goal number one, providing authentic and innovative learning opportunities in science, were all positive. Some indicated they would like even more opportunities. Goal number two, the application of high level of science, math and technology was also deemed successful. The students agreed that science was 'definitely achieved' as well as technology being the 'most applied'. Math was the one component that students felt was not achieved. All three WCP students interviewed agreed that WCP goal number three, enrichment for students to develop further interest in careers in science and engineering, was accomplished.

Goal number four of developing collaborative opportunities with post secondary institutions and/or industry on a local, national and international level would also be considered a success. Students described opportunities to visit local and U. S. universities, meet with local industry personnel, and tour aerospace facilities.

Goal number five, raising the profile of aerospace in school and the community had mixed interpretations of success. Two students agreed that this goal was achieved and that they were made aware of the local aerospace industry. The third student pointed out that the WCP is not known by most students attending the school that is the subject of this research project. The student said that more needed to be done to promote the WCP in the school. Which leads to the final question in the interview, what can be done to improve the WCP? One of the main suggestions was to recruit more students into the program and work at retaining them. They suggested that the program 'advertise more' and get more students from grades 9 and 10. There was a suggestion to incorporate WCP activities into regular classrooms so students would not feel so intimidated about joining the WCP.

It appears that a large proportion of the student population at the targeted school were unaware of the WCP. There is also a disinterest in joining the project based on the perceived activities that have identified as being boring and uninteresting by students who have not heard of the WCP until the survey. Yet students who have participated in the WCP acknowledge the variety of experiences the WCP provides. There were no other predetermining factors to indicate potential student participation in the WCP (ex. course choices, peer influences, other extracurricular activities). What was apparent is student understanding, self-efficacy, and positive attitude toward extracurricular activities such as the WCP.

In order to generate more interest in activities like the WCP, activity content should be included in existing courses where aerospace content applies. This would provide students an opportunity to see the application of content that they may not have understood previously. This may generated interest in the topic and have students explore the possibility of experiencing opportunities and possible career choices related to the field of aerospace.

6.2 Limitations of the Study

There are a number of limitations identified with respect to this study:

1. The majority of students completing the questionnaire were from a small group of students from two Geography classes. Although one group from first semester was now spread through four core grade 10 classes, the sample was confined by the Geography classes as a targeted group. The four core classes did provide randomness to the sampling.
2. The student sampling for the questionnaire originated at the grade 10 level. Other grade levels were not sampled. This provided a limited focus of student participants. The conclusions arrived at may not be applicable to other grade levels.
3. The categories created for analysis of the grade 10 responses to the questionnaire was decided by the researcher based on student responses to the question of whether or not the student in the survey were interested in the WCP. All conclusions with regards to the grade 10 results are based on this categorization.
4. The personal interviews were open to all past and present WCP participants at the targeted school. Only a small number of active members of the WCP took part in the interview. The views of the WCP are therefore based on those students still interested in the WCP as indicated by their continued participation. Unfortunately the views of those students who were no longer participating were not included. Students that have withdrawn from the WCP and were still attending the targeted school were approached to participate in the questionnaire and interview, but declined.

5. Students who have participated in the WCP and have since graduated, were not available to be asked to partake in the survey. Their input would have provided insight from a post-secondary perspective.
6. The responses were limited to a single participating high school within the WCP. Socioeconomic status and school culture may make the conclusions found here to be applicable only to the targeted school.
7. Teachers that were involved with the WCP at the targeted school were not included in the sampling of data. The researcher was aware of their thoughts and ideas on how to improve the delivery of the WCP. It was thought, however by the principal researcher to focus on the student perspective, which was not fully known, compared to that of the adult supervisors. The teacher perspective is valuable, but not the focus of this study.

6.3 Implications of the Study

This study looked at the influences of student participation in an extracurricular aerospace program. The WCP is a unique program in North America and is a constantly evolving learning endeavor dedicated to the education of students in the field of aerospace. To this end, the conclusions drawn from this study can perhaps help with the development of aerospace or science extracurricular activities being offered to high school students.

1. Encouraging the participation of students in extracurricular programs requires significant promotion. This promotion must ensure awareness and counteract the prevalence of negative perceptions students have towards topics such as space science and their own efficacy in these areas. It was apparent from comments

made by present WCP participants that students in the targeted school were not aware of the program. From the grade 10 survey, 74% of students hadn't heard of the WCP until reading the questionnaire.

2. Inclusion of aspects of the extracurricular activity in current classroom settings may help with student issues around self-efficacy and the proposed activity. Based on the results of student reflections on the perceived level of importance space-related topics has received in their early, middle, and high school years was incredibly low. Of the grade 10 students surveyed, 80% felt the level of importance at the early and middle school level was 'some' to 'a little' and at the high school that number was 72% with an additional 21% indicating there was 'nothing'. Without exposure to a variety of space related topics, students will not be able to make informed decisions about joining an activity like the WCP because they may not feel they don't have the necessary background knowledge or skills. Their lack of familiarity with WCP concepts are reflected in their comments about how the activities sound 'boring' and uninteresting. Students need to be made aware of various aspects of a field of study to determine if there personal interest, self-determination and self-efficacy to allow further study. By including aerospace links to existing curriculum within a participating school, students may understand the content and expectations of a program like the WCP.
3. In order to achieve implication number two, an extracurricular activity needs to develop supplementary materials for teachers of participating schools that can be used to enhance curriculum delivery. There may be reluctance for potential participating teachers to become involved with extracurricular activities because

of their own self-efficacy issues relating to content and skills associated with that activity. By providing materials and training, extracurricular activities such as the WCP can be incorporated into classrooms on a larger scale.

4. Schools looking to promote a particular extracurricular activity such as the WCP need to provide demonstrations of some of the programs offerings to the student body to encourage involvement. This would augment the inclusion of subject material relating to the extracurricular activity that has been suggested in implication two.
5. By exposing students to various learning opportunities, an interest may be developed in students that could lead to career decisions and pursuit of scientific, engineering, and technology related fields. Programs that are trying to have students explore various career choices as part of a science, technology, engineering and mathematics (STEM) must keep this in mind. The WCP has strived to accomplish its goal of providing enrichment for students to develop further interest in science and engineering which was reflected in participating WCP students who commented that it made them "even more interested in science" and gave them "more of a perspective of what engineering was."
6. To increase student retention within an extracurricular science activity, team-building activities need to be incorporated into the program. The WCP participants suggested team building activities to help with retention of members in the program. This will serve to strengthen the group and will allow the group to develop a "set of norms for a wide range of behaviors and long-term

expectations and aspirations, thus influencing behaviors across several domains" (Eccles & Barber, 1999, p. 31).

7. The WCP must re-evaluate the inclusion of math in its offerings if it is to maintain that subject as part of goal number two, *the application of high level science, math and technology*. The WCP participants stated that although goal number two was being achieved in science and technology, the application of math was missing.
8. A student advisory board should be created to provide student input in the review and development of extracurricular offerings. WCP participants in their interviews cited the need for students to "have had more to say in the project".
9. Increase parental involvement to reinforce science education outside of school through various events and promotion. It is apparent from the results of the family based questions in the questionnaire that students do not see a relevance of what they learn in school and their activities experienced at home. For example, some students surveyed indicated that they only actively research scientific concepts at home if its part of a school assignment. Activities and resources for students and families need be developed to help foster positive attitudes toward science in school and at home.

6.4 Recommendations for Further Research

There are a number of recommendations for further research in regards to aerospace extracurricular program participation evaluation.

1. This particular study should be expanded to include grade level 9 to 11 for greater feedback on student population views.

2. The student sample should be expanded to include student populations from various high schools for a wider perspective on aerospace extracurricular activities.
3. Further study is recommended for the level of space-related education exposure at the early/middle and high school levels.
4. Research should be carried out on the effect of inclusion of aerospace related in regular classes and the impact on self-efficacy and interest in the subject.
5. The impact of home experiences around science related activity needs to be investigated. Perhaps an intervention to develop more interaction between students and parents could be attempted.

6.5 Closing Comments

I have been a teacher at Maples Collegiate for the past fifteen years as a science teacher. During that time I have initiated a number of space initiatives for the student body to experience. I have been involved with the WCP since its inception. The program has had numerous growing pains due to its uniqueness with no similar organizations to learn from.

One of the issues for me as a WCP Advisory Committee member and as co-chair of the WCP is to establish a strong student base of participation. This research project has provided an extensive look at the WCP offering at my school. I plan to begin looking at the inclusion of aerospace related content and activities in the existing curriculum with teachers at my school. Perhaps the inclusion of aerospace materials and activities in the school and community will help establish the WCP as a major opportunity for students as an extracurricular program for high schools in Manitoba.

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APPENDIX A: Pan-Canadian Curriculum Links

A.1 Skills General Learning Outcomes

By the end of grade 12
It is expected that students will…

Initiating and Planning
216 ask questions about observed relationships and plan investigations of questions, ideas, problems, and issues

Performing and Recording
217 conduct investigations into relationships between and among observable variables, and use a broad range of tools and techniques to gather and record data and information

Analysing and Interpreting
218 analyse data and apply mathematical and conceptual models to develop and asses possible explanations

Communication and Teamwork
219 work as a member of a team in addressing problems, and apply the skills and conventions of science in communicating information and ideas and in assessing results

(CMEC, 1997, p. 195)

A.1.1 Specific Learning Outcomes: Initiating and Planning

By the end of grade 12
It is expected students will …

212-1 identify questions to investigate that arise from practical problems and issues
212-2 define and delimit problems to facilitate investigation
212-3 design and experiment identifying and controlling major variables
212-4 state a prediction and a hypothesis based on available evidence and background information
212-5 identify the theoretical basis of an investigation and develop a prediction and a hypothesis that are consistent with the theoretical basis
212-6 design an experiment and identify specific variables
212-7 formulate operational definitions of major variables
212-8 evaluate and select appropriate instruments for collecting evidence and appropriate processes for problem solving, inquiring, and decision making
212-9 develop appropriate sampling procedures

(CMEC, 1997, p. 81)

A1.2 Specific Learning Outcomes: Performing and Recording

By the end of grade 12
It is expected students will ...

213-1 implement appropriate sampling procedures
213-2 carry out procedures controlling the major variables and adapting or extending procedures where required
213-3 use instruments effectively and accurately for collecting data
213-4 estimate quantities
213-5 compile and organize data, using appropriate formats and data treatments to facilitate interpretation of the data
213-6 use library and electronic research tools to collect information on a given topic
213-7 select and integrate information from various print and electronic sources or from several parts of the same source
213-8 select and use apparatus and materials safely

(CMEC, 1997, p. 82)

A.1.3 Specific Learning Outcomes: Analysing and Interpreting

By the end of grade 12
It is expected students will ...

214-3 compile and display evidence and information, by hand or computer, in a variety of formats, including diagrams, flow charts, tables, graphs, and scatter plots
214-4 identify a line of best fit on a scatter plot and interpolate or extrapolate based on the line of best fit
214-5 interpret patterns and trends in data, and infer or calculate linear and nonlinear relationships among variables
214-6 apply and assess alternative theoretical models for interpreting knowledge in a given field
214-7 compare theoretical and empirical values and account for discrepancies
214-8 evaluate the relevance, reliability, and adequacy of data and data collection methods
214-9 identify and apply criteria, including the presence of bias, for evaluating evidence and sources of information
214-10 identify and explain sources of error and uncertainty in measurement and express results in a form that acknowledges the degree of uncertainty
214-11 provide a statement that addresses the problem or answers the question investigated in light of the ling between data and conclusion
214-12 explain how data support or refute the hypothesis or prediction
214-13 identify and correct practical problems in the way a technological device or system functions
214-14 construct and test a prototype of a device or system and troubleshoot problems as they arise
214-15 propose alternative solutions to a given practical problem, identify the potential strengths and weaknesses of each, and select one as the basis for a plan

214-16 evaluate a personally designed and constructed device on the basis of criteria they have developed themselves
214-17 identify new questions or problems that arise form what was learned
214-18 identify and evaluate potential applications of findings
(CMEC, 1997, p. 83)

A.1.4 Specific Learning Outcomes: Communication and Teamwork

By the end of grade 12
It is expected students will …

215-1 communicate questions, ideas, and intentions, and receive, interpret, understand, support, and respond to the ideas of others
215-2select and use appropriate numeric, symbolic, graphical, and linguistic modes of representation to communicate ideas, plans, and results
215-3 synthesize information from multiple sources or form complex and lengthy texts and make inferences based on this information
215-5 develop, present and defend a position or course of action, based on findings
215-6 work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise
215-7evaluate individual and group processes used in planning, problem solving and decision making, and completing a task
(CMEC, 1997, p. 84)

A.2 General Learning Outcomes: Earth and Space Science

- Earth and space science (by the end of grade 9)
  - Explain how Earth provides both a habitat for life and a resource for society
  - Describe the nature and components of the universe (p. 28)

- Earth and space science (by the end of grade 12)
  - Demonstrate an understanding of the nature and diversity of energy source and matter in the universe
  - Describe the nature of space and its components and the history of the observation of space (p. 29)

(CMEC, 1997)

APPENDIX B: Manitoba Curriculum Links

The following are examples of general (GLO) and specific learning outcomes (SLO) of curriculum mentioned in this project. Only those specific outcomes that apply to the WinCube Project are recorded here.

B.1: Manitoba General Learning Outcomes

(Manitoba Education, Citizenship and Youth, 2006)
Manitoba curriculum General Learning Outcomes for Early, Middle, and Senior Years science education within the Province of Manitoba, in which the WCP operates in.

B.1.1: GLO A

Nature of Science and Technology General Learning Outcomes

- A1: Recognize both the power and limitations of science as a way of answering questions about the world and explaining natural phenomena
- A2: Recognize that scientific knowledge is based on evidence, models, and explanations, and evolves as new evidence appears and new conceptualizations develop
- A3: Distinguish critically between science and technology in terms of their respective contexts, goals, methods, products, and values
- A4: Identify and appreciate contributions made by women and men from many societies and cultural backgrounds towards increasing our understanding of the world and in bringing about technological innovations
- A5: Recognize that science and technology interact with and advance one another

(Manitoba Education, Citizenship and Youth, 2006, p. 7)

B.1.2: GLO B

Science, Technology, Society, and the Environment (STSE) General Learning Outcomes

- B1: Describe scientific and technological developments, past and present, and appreciate their impact on individuals, societies, and the environment, both locally and globally
- B2: Recognize that scientific and technological endeavours have been and continue to be influenced by human needs and the societal context of the time
- B4: Demonstrate a knowledge of and personal consideration for a range of possible science and technology-related interests, hobbies, and careers
- B5: Identify and demonstrate actions that promote a sustainable environment, society, and economy, both locally and globally

(Manitoba Education, Citizenship and Youth, 2006, p. 9)

B.1.3: GLO C

Scientific and Technological Skills and Attitudes General Learning Outcomes

- C1: Recognize safety symbols and practices related to scientific and technological activities and to their daily lives, and apply this knowledge in appropriate situations
- C2: Demonstrate appropriate scientific inquiry skills when seeking answers to questions
- C3: Demonstrate appropriate problem-solving skills while seeking solutions to technological challenges
- C4: Demonstrate appropriate critical thinking and decision-making skills when choosing a course of action based on scientific and technological information
- C5: Demonstrate curiosity, skepticism, creativity, open-mindedness, accuracy, precision, honesty, and persistence, and appreciate their importance as scientific and technological habits of mind
- C6: Employ effective communication skills and utilize information technology to gather and share scientific and technological ideas and data
- C7: Work cooperatively and value the ideas and contributions of others while carrying out scientific and technological activities
- C8: Evaluate, from a scientific perspective, information and ideas encountered during investigations and in daily life

(Manitoba Education, Citizenship and Youth, 2006, pp. 11-12)

B.1.4: GLO D

Essential Science Knowledge General Learning Outcomes

- D4: Understand how stability, motion, forces, and energy transfers and transformations play a role in a wide range of natural and constructed contexts
- D5: Understand the composition of the Earth's atmosphere, hydrosphere, and lithosphere, as well as the processes involved within and among them
- D6: Understand the composition of the universe, the interactions within it, and the impacts of humankind's continued attempts to understand and explore it

(Manitoba Education, Citizenship and Youth, 2006, p. 13)

B.1.5: GLO E

Unifying Concepts General Learning Outcomes

- E1: Describe and appreciate the similarity and diversity of forms, functions, and patterns within the natural and constructed world
- E2: Describe and appreciate how the natural and constructed world is made up of systems and how interactions take place within and among these systems
- E4: Recognize that energy, whether transmitted or transformed, is the driving force of both movement and change, and is inherent within materials and in the interactions among them

(Manitoba Education, Citizenship and Youth, 2006, P. 14)

B.2: Senior 1 Science

(Manitoba Education and Training, 2000)

B.2.1: Prescribed Learning Outcomes:

- S1-4-09: Explain how various technologies have extended our ability to explore and understand space. (p. 4.26)
- S1-4-10: Investigate ways in which Canada participates in space research and in international space programs, and then use the decision-making process to address a related issue. (p. 4.28)
- S1-4-11: Evaluate the impact of space science and technologies in terms of their benefits and risks to humans. (p. 4.30)
- S1-4-11: Evaluate the impact of space science and technologies in terms of their benefits and risks to humans. (4.32)

B.3: Senior 2 Science

(Manitoba Education, Training and Youth, 2001)

B.3.1: Prescribed Learning Outcomes for Physics:

- S2-3-01 Analyze the relationship among displacement, time, and velocity for an object in uniform motion.
- S2-3-03 Analyze the relationships among velocity, time, and acceleration for an object that is accelerating at a constant rate.
- S2-3-04 Outline the historical development of the concepts of force and "natural" motion.
- S2-3-05 Experiment to illustrate the effects of inertia in car collisions.
- S2-3-06 Describe qualitatively how force is related to motion.
- S2-3-07 Investigate and describe qualitatively Newton's Third Law.
- S2-3-08 Define momentum and impulse and qualitatively relate impulse to change in momentum for everyday situations.
- S2-3-09 Investigate the conservation of energy in a motor vehicle collision.
- S2-3-10 Investigate conditions that illustrate the effects of friction on motion.

(pp. 3.20-3.21)

B.3.2: Prescribed Learning Outcomes for Weather:

- S2-4-01 Illustrate the composition and organization of the hydrosphere and the atmosphere.
- S2-4-02 Outline factors influencing the Earth's radiation budget.
- S2-4-03 Explain effects of heat transfer within the atmosphere and hydrosphere on the development and movement of wind and ocean currents.
- S2-4-04 Explain the formation and dynamics of selected severe weather phenomena.
- S2-4-05 Collect, interpret, and analyze meteorological data related to a severe weather event.
- S2-4-06 Investigate the social, economic, and environmental impacts of a recent severe weather event.
- S2-4-07 Investigate and evaluate evidence that climate change occurs naturally and can be influenced by human activities.
- S2-4-08 Discuss potential consequences of climate change.

(p. 3.22)

B.4: Senior 3 Physics

(Manitoba Education and Youth, 2003)

B.4.1: Waves in One Dimension

Prescribed Learning Outcomes:

- S3P-1-01 Describe a wave as a transfer of energy.
- S3P-1-02 Describe, demonstrate, and diagram the characteristics of transverse and longitudinal waves.
- S3P-1-03 Compare and contrast the frequency and period of a periodic wave.
- S3P-1-04 Derive and solve problems, using the wave equation ($v = f\lambda$).
- S3P-1-05 Describe, demonstrate, and diagram the transmission and reflection of waves travelling in one dimension.
- S3P-1-06 Use the principle of superposition to illustrate graphically the result of combining two waves.
- S3P-1-07 Investigate the historical development of a significant application of communications technology that uses waves.

(1.1 p. 5)

B.4.2: Waves in Two Dimensions

Prescribed Learning Outcomes:

- S3P-1-08 Describe and give examples of two-dimensional waves.
- S3P-1-09 Compare and contrast a wavefront and a wave ray.
- S3P-1-10 Describe, demonstrate, and diagram the reflection of plane (straight) and circular waves.
- S3P-1-11 Describe, demonstrate, and diagram the refraction of plane (straight) waves.
- S3P-1-15 Describe, demonstrate, and diagram how constructive and destructive interference produce an interference pattern from two point sources.

(1.2 p. 25)

B.4.3: Particle and Wave Models of Light:

Prescribed Learning Outcomes:

- S3P-2-15 Describe light as an electromagnetic wave.

(2.2 p. 15)

B.4.4: Kinematics:

Prescribed Learning Outcomes:

- S3P-3-01: Differentiate between, and give examples of, scalar and vector quantities.
- S3P-3-02: Differentiate among position, displacement, and distance.
- S3P-3-03: Differentiate between the terms "an instant" and "an interval" of time.
- S3P-3-04: Analyze the relationships among position, velocity, acceleration, and time for an object that is accelerating at a constant rate.
- S3P-3-05: Compare and contrast average and instantaneous velocity for nonuniform motion.

(3.1 p. 5)

B.4.5: Dynamics:

Prescribed Learning Outcomes:

- S3P-3-08: Identify the four fundamental forces of nature.
- S3P-3-11: Define as the vector sum of all forces acting on a body.
- S3P-3-12: Construct free-body diagrams to determine the net force for objects in various situations.
- S3P-3-13: Solve problems, using Newton's Second Law and the kinematics equations

(3.2 p. 27)

B.4.6: Gravitational Fields

Prescribed Learning Outcomes:

- S3P-4-01: Define the gravitational field qualitatively as the region of space around a mass where another point mass experiences a force.
- S3P-4-02: Diagram the Earth's gravitational field, using lines of force.
- S3P-4-03: Define the gravitational field quantitatively as a force per unit mass.
- S3P-4-04: Compare and contrast the terms "mass" and "weight."
- S3P-4-05: Describe, qualitatively and quantitatively, apparent weight changes in vertically accelerating systems.
- S3P-4-06: Derive the acceleration due to gravity from free fall and Newton's laws.
- S3P-4-08: Solve free-fall problems.
- S3P-4-09: Describe terminal velocity, qualitatively and quantitatively.

(p. 4.1 p. 5)

B.4.7: Magnetic Fields

Prescribed Learning Outcomes:

- S3P-4-20: Define the magnetic field as the region of space around a magnet where another magnet will experience a force.
- S3P-4-21: Demonstrate and diagram magnetic fields, using lines of force.
- S3P-4-22 Describe the concept of magnetic poles and demonstrate that like poles repel and unlike poles attract.
- S3P-4-23: Describe magnetism, using the domain theory.
- S3P-4-24: Investigate the influence and effects of the magnetic field of the Earth.

(4.3 p.34)

B.4.8: Electromagnetism

Prescribed Learning Outcomes:

- S3P-4-25: Describe and demonstrate the phenomenon of electromagnetism.
- S3P-4-26: Diagram and describe qualitatively the magnetic field around a current carrying wire.
- S3P-4-27: Diagram and describe qualitatively the magnetic field of a solenoid.
- S3P-4-28: Describe and demonstrate the function of an electromagnet.

B.5: Senior 4 Physics

(Manitoba Education, Citizenship and Youth, 2005)

B.5.1: Momentum

Prescribed Learning Outcomes:

- S4P-1-10 Derive the impulse-momentum equation from Newton's second law.
- S4P-1-13 Solve problems using the impulse-momentum equation and Law of Conservation of Momentum.
- S4P-1-14 Relate the impulse-momentum equation to real-life situations.

(1.3 p. 25)

B.5.2: Projectile Motion

Prescribed Learning Outcomes:

- S4P-1-15 Solve simple free-fall problems using the special equations for constant acceleration.
- S4P-1-16 Draw free-body diagrams for a projectile at various points along its path (with and without air resistance).
- S4P-1-17 Calculate the horizontal and vertical components with respect to velocity and position of a projectile at various points along its path.
- S4P-1-18 Solve problems for projectiles launched horizontally and at various angles to the horizontal to calculate maximum height, range, and overall time of flight of the projectile.

(1.4 p. 37)

B.5.3: Circular Motion

Prescribed Learning Outcomes:

- S4P-1-19 Explain qualitatively why an object moving at constant speed in a circle is accelerating toward the centre of the circle.
- S4P-1-20 Discuss the centrifugal effects with respect to Newton's laws.
- S4P-1-21 Draw free-body diagrams of an object moving in uniform circular motion.
- S4P-1-22 Experiment to determine the mathematical relationship between period and frequency and one or more of the following: centripetal force, mass, and radius.
- S4P-1-23 Derive an equation for the constant speed and acceleration of an object moving in a circle
- S4P-1-24 Solve problems for an object moving with a constant speed in a circle

(1.5 p. 47)

B.5.4: Work and Energy

Prescribed Learning Outcomes:

- S4P-1-25 Define work as the product of displacement and the component of force parallel to the displacement when the force is constant.
- S4P-1-26 Determine work from the area under the force-position graph for any force.
- S4P-1-27 Describe work as a transfer of energy.
- S4P-1-28 Give examples of various forms of energy and describe qualitatively the means by which they can perform work.
- S4P-1-33 Solve problems related to the conservation of energy.

(1.6 p. 60)

B.5.5: Exploration of Space

Prescribed Learning Outcomes:

- S4P-2-1 Identify and analyze issues pertaining to space exploration.
- S4P-2-2 Describe planetary motion using Kepler's three laws.
- S4P-2-3 Outline Newton's Law of Universal Gravitation and solve problems using
- S4P-2-5 Solve problems for the escape velocity of a spacecraft.

(2.1 p.4)

B.5.6: Low Earth Orbit

Prescribed Learning Outcomes:

- S4P-2-6 Compare the Law of Universal Gravitation with the weight (mg) of an object at various distances from the surface of the Earth
- S4P-2-7 Outline Newton's thought experiment regarding how an artificial satellite can be made to orbit the earth.
- S4P-2-8 Use the Law of Universal Gravitation and circular motion to calculate the characteristics of the motion of a satellite.
- S4P-2-9 Define microgravity as an environment in which the apparent weight of a system is smaller than its actual weight.
- S4P-2-10 Describe conditions under which microgravity can be produced.
- S4P-2-11 Outline the factors involved in the re-entry of an object into Earth's atmosphere.

(2.2 p. 18)

B.5.7: Electric and Magnetic Fields

Prescribed Learning Outcomes:

- S4P-2-13 Compare and contrast the inverse square nature of gravitational and electric fields.
- S4P-2-15 Illustrate, using diagrams, how the charge distribution on two oppositely charged parallel plates results in a uniform field.
- S4P-2-16 Derive an equation for the electric potential energy between two oppositely charged parallel plates.
- S4P-2-17 Describe electric potential as the electric potential energy per unit charge.
- S4P-2-18 Identify the unit of electric potential as the volt.
- S4P-2-21 Use hand rules to describe the directional relationships between electric and magnetic fields and moving charges.
- S4P-2-22 Describe qualitatively various technologies that use electric and magnetic fields.

(2.3 p. 37)

B.5.8: Electric Circuits

Prescribed Learning Outcomes:

- S4P-3-1 Describe the origin of conventional current and relate its direction to the electron flow in a conductor.
- S4P-3-2 Describe the historical development of Ohm's Law.
- S4P-3-3 Investigate the relationships among resistance and resistivity, length, cross-section, and temperature.
- S4P-3-4 Demonstrate the ability to construct circuits from schematic diagrams for series, parallel, and combined networks.
- S4P-3-5 Calculate the total resistance for resistors in series and resistors in parallel.
- S4P-3-6 Calculate the resistance, current, voltage, and power for series, parallel, and combined networks.

(3.1 p. 3)

B.5.9: Electromagnetic Induction

Prescribed Learning Outcomes:

- S4P-3-8 Demonstrate how a change in magnetic flux induces voltage.
- S4P-3-9 Calculate the magnitude of the induced voltage in coils using V
- S4P-3-10 Outline Lenz's Law and apply to related problems.
- S4P-3-11 Describe the operation of an AC generator.
- S4P-3-12 Graph voltage versus angle for the AC cycle.
- S4P-3-13 Describe the operation of transformers.
- S4P-3-14 Solve problems using the transformer ratio
- S4P-3-15 Describe the generation, transmission, and distribution of electricity in Manitoba.

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Appendix C: WinCube Questionnaire

Instructions:

- For the following multiple choice questions, please place an 'X' to indicate your answer
- When asked for elaboration of your multiple choice question, please be as concise as you can

1. I am:
   i. ___ Female
   j. ___ Male

2. Age:
   a. ___ 15
   b. ___ 16
   c. ___ 17
   d. ___ 18

3. I am presently enrolled in grade:
   a. ___ 9
   b. ___ 10
   c. ___ 11
   d. ___ 12

4. Please indicate which science and math courses you have ***completed*** at school (Check all that apply):

   a. ___ Grade 9 Math
   b. ___ Grade 10 Consumer Math
   c. ___ Grade 11 Consumer Math
   d. ___ Grade 12 Consumer Math
   e. ___ Grade 10 Pre-Cal Math
   f. ___ Grade 11 Pre-Cal Math
   g. ___ Grade 12 Pre-Cal Math
   h. ___ Grade 9 Science
   i. ___ Grade 10 Science
   j. ___ Grade 11 Biology
   k. ___ Grade 12 Biology
   l. ___ Grade 11 Chemistry
   m. ___ Grade 12 Chemistry
   n. ___ Grade 11 Physics
   o. ___ Grade 12 Physics
   p. ___ Grade 11 Computer Science
   q. ___ Grade 12 Computer Science

If you are graduating this year, please go to question #6

5. Please indicate which science and math courses you ***plan to take*** at school in the future (Check all that apply):

a. ___ Grade 9 Math
b. ___ Grade 10 Consumer Math
c. ___ Grade 11 Consumer Math
d. ___ Grade 12 Consumer Math
e. ___ Grade 10 Pre-Cal Math
f. ___ Grade 11 Pre-Cal Math
g. ___ Grade 12 Pre-Cal Math
h. ___ Grade 9 Science
i. ___ Grade 10 Science
j. ___ Grade 11 Biology
k. ___ Grade 12 Biology
l. ___ Grade 11 Chemistry
m. ___ Grade 12 Chemistry
n. ___ Grade 11 Physics
o. ___ Grade 12 Physics
p. ___ Grade 11 Computer Science
q. ___ Grade 12 Computer Science

6. What are your three most favorite subjects in high school?

#1: ________________ #2: ________________ #3: ________________

7. What are your three least favorite subjects in high school?

#1: ________________ #2: ________________ #3: ________________

8. When I graduate from high school, I plan to:
   a. ___ Go straight to work (please proceed to question 12)
   b. ___ Go to College
   c. ___ Go to University

9. Please state the field of study you plan to enter at University/College:

10. When you go to University/College, do you intend to take any courses in the following disciplines (please check all that apply)?
   a. ___ Physics
   b. ___ Computer Science
   c. ___ Engineering
   d. ___ Astronomy
   e. ___ Math
   f. ___ Biology
   g. ___ Chemistry

11. Please indicate the career you would like to do after graduating from University/College:

Proceed to question #13

12. Please state the occupation you plan to work at after graduating from high school:

13. Please indicate all activities that you are involved with at school (ex. Volleyball, basketball, drama production, Unity Group)

14. Please indicate all activities that you are involved with outside of school (ex. Dance group, volunteering)

15. The following family members have a university or college degree (please identify the field of study):
    a. ___ Mother (field of study: ______________)
    b. ___ Father (field of study: ______________)
    c. ___ Sister (field of study: ______________)
    d. ___ Sister (field of study: ______________)
    e. ___ Brother (field of study: ______________)
    f. ___ Brother (field of study: ______________)

16. Do you get help with your science homework at home?
    a. ___ No
    b. ___ Yes

If Yes, from whom?

17. How often do you watch scientific television programs or documentaries related to space topics?

____ Always	____ Frequently	____ Seldom	____ Never

If you do watch space related shows, which ones?

If never, why not?

18. Does anyone else at home watch scientific television programs or documentaries related to space topics?
    a. ___ No
    b. ___ Yes

If yes, who and what shows?

19. How often do you read a scientific article related to space in the printed press (ex. Newspaper, magazine)?

____ Always	____ Frequently	____ Seldom	____ Never

If you do read space related topics, which sources do you read?

If never, why not?

20. Does anyone in your home read scientific articles related to space in the printed press (ex. Newspaper, magazine)?
    a. ___ No
    b. ___ Yes

If yes, who and what are the sources?

21. How often do you surf Internet sites related to space topics?

____ Always	____ Frequently	____ Seldom	____ Never

If never, why not?

22. Does anyone in your home surf Internet sites related to space topics?
    a. ___ No
    b. ___ Yes

If yes, who and what are the sources?

23. Do you do science related activities outside your home with your family? (ex. Planetarium, science museum)
    a. ___ No
    b. ___ Yes

If yes, what have you visited?

24. How often do you go to the theatre to watch science fiction movies about space and space related topics?

____ Always	____ Frequently	____ Seldom	____ Never

If never, why not?

25. What three courses are your closest friends' most favorite subjects in high school?

#1: ________________ #2: ________________ #3: ________________

26. What three courses are your closest friends' least favorite subjects in high school?

#1: ________________ #2: ________________ #3: ________________

27. List your three favorite topics relating to space:

#1: ________________ #2: ________________ #3: ________________

28. How much importance do you feel has been given to space and space-related topics, in the context of your early and middle school education?

    ____ A lot ____ Some ____ A little ____ Nothing

29. How much importance do you feel has been given to space and space-related topics, in the context of your high-school education?

    ____ A lot ____ Some ____ A little ____ Nothing

30. Have you ever heard of the WinCube Project at your school?
    a. ___ No
    b. ___ Yes

If no, please continue to question #32

31. Have you ever participated in the WinCube Project at your school?
    a. ___ No
    b. ___ Yes

If yes, please continue to question #39

32. Below is a description of the WinCube Project:

The WinCube Project is a multifaceted program designed to engage Manitoba high school students in areas of science, technology and engineering as it relates to the field of aerospace. The project provides a number of unique learning opportunities including a small satellite project (CubeSat), high altitude balloon missions (BCube), an Amateur Radio Course (ARC), the WinCube Ground Station (WinGS), the Manitoba Space Adventure Camp (MSAC), an Introductory Aerospace Design Course (IADC), and numerous tours of University research facilities and aerospace industries.

The CubeSat project is run in conjunction with the University of Manitoba's Faculty of Engineering, who are designing and building a small satellite for the WinCube Project. The satellite will be placed in low earth orbit within the next two to three years. The collective group of high school students in Manitoba that are part of the WinCube Project are provided the opportunity to interact with the Engineering students who are constructing the satellite. The high school students are also responsible for developing the onboard science component of the satellite. Once in orbit, high school students will be able to communicate and download information from the WinCube CubeSat.

Based on the description of the CubeSat small satellite project, would you ever consider joining this component of the WinCube Project?

a. ___ No
b. ___ Yes

Why or why not? Please explain your answer.

33. The BCube component of the WinCube Project has high school students building scientific payloads that are launched into the atmosphere to altitudes over 30 km. Students are responsible for onboard computer programming, scientific experimentation, tracking when in flight, and retrieval of the payload at the end of the mission.

Based on the description of the BCube, would you ever consider joining this component of the WinCube Project?

a. ___ No
b. ___ Yes

Why or why not? Please explain your answer.

34. The Amateur Radio Course (ARC) provides an opportunity for participating high school students the opportunity to receive their amateur radio license with Industry Canada. The amateur radio license allows students to operate the radio tracking equipment used in the BCube, as well as operating the WinCube Ground Station (WinGS) used in communicating with satellites in low earth orbit.

Based on the description of the Amateur Radio Course (ARC), would you ever consider joining this component of the WinCube Project?

a. ___ No
b. ___ Yes

Why or why not? Please explain your answer.

35. The WinCube Ground Station (WinGS) is located at the Engineering and Information Technology Complex at the University of Manitoba. The ground station is used to communicate with low earth orbiting satellites. The station will also communicate with astronauts onboard the International Space Station and link the conversation with other schools from around the world. WinCube students that have their amateur radio licenses will be involved with the operation of the station.

Based on the description of the WinCube Ground Station (WinGS), would you ever consider joining this component of the WinCube Project?

a. ___ No
b. ___ Yes

Why or why not? Please explain your answer.

36. The Manitoba Space Adventure Camp (MSAC) is a weeklong program offered in July. The program consists of hands on opportunities as small rocket construction and launch, computer simulations, and a high altitude balloon launch and retrieval (BCube). Lectures topics include space mission design, space law, and workshops put on by the Canadian Space Agency. Tours of local aerospace industry and Faculty of Engineering labs are also provided.

Based on the description of the Manitoba Space Adventure Camp (MSAC), would you ever consider joining this component of the WinCube Project?

a. ___ No
b. ___ Yes

Why or why not? Please explain your answer.

37. Based on the above descriptions of WinCube, do you find the overall project appealing?
    a. ___ No
    b. ___ Yes

Why or why not? Please explain your answer.

38. What activities in the WinCube Project sound interesting (check all that apply)?
- ___ CubeSat (picosatellite)
- ___ BCube (high altitude balloon)
- ___ Amateur Radio Class
- ___ Manitoba Space Adventure Camp
- ___ Satellite Ground Station
- ___ Introductory Aerospace Design Course
- ___ Industry tours
- ___ Working with Universities

You have completed the survey. Thank you for participating.

39. Please indicate what activities you have participated in regards to the WinCube Project: (Check all that apply)
    a. ___ CubeSat (picosatellite)
    b. ___ BCube launch – Fall 2008
    c. ___ BCube launch - University of North Dakota Spring 2007
    d. ___ Amateur Radio Certification – 2006-2007
    e. ___ Amateur Radio Certification – 2007-2008
    f. ___ Manitoba Space Adventure Camp 2006
    g. ___ Manitoba Space Adventure Camp 2007
    h. ___ Satellite Ground Station
    i. ___ Introductory Aerospace Design Course – 2007-2008
    j. ___ Electronic Workshop – 2006
    k. ___ Engineering presentation on Cubesat – Spring 2008
    l. ___ Amateur radio Faculty of Engineering tour (U of M) - 2008

42. Will you be participating in any of the following upcoming activities? (Check all that apply)
    a. Manitoba Space Adventure Camp July 2009
        a. ___ Yes
        b. ___ No

Why or why not?

b. BCube launch - June 2009

a. ___ Yes

b. ___ No

Why or why not?

c. BCube launch – Winnipeg Amateur Radio Club – June 30 2009

a. ___ Yes

b. ___ No

Why or why not?

43. Since you have indicated that you have participated in the WinCube Project in at least one activity, are you willing to participate in a follow up questionnaire and survey?

    a. ___ No

    b. ___ Yes

If you answered No, you have completed the survey. Thank you for participating.

If you answered Yes, please see your classroom teacher to make arrangements for the follow-up questionnaire and survey. Thank you for completing this portion of the survey.

APPENDIX D: Questionnaire Results

1-3. Demographics

	Female Yes		Female No		Male Yes		Male No	
Age	n	%	n	%	n	%	n	%
15	9	45%	19	53%	8	73%	9	27%
16	11	55%	17	47%	3	27%	23	70%
17	0	0%	0	0%	0	0%	1	3%
Average	15.6		15.5		15.3		15.8	
Total	20		36		11		33	
Grade								
10	18	90%	35	97%	11	100%	31	94%
11	2	10%	1	3%	0	0%	2	6%

4. Please indicate which science and math courses you have ***completed*** at school.

	Female Yes		Female No		Male Yes		Male No	
Grade 10	n	%	n	%	n	%	n	%
Consumer	6	30%	18	50%	0	0%	8	24%
Pre-Cal	9	45%	12	33%	7	64%	18	55%
Science	10	50%	23	64%	10	91%	25	76%
Grade 11								
Pre-Cal	0	0%	0	0%	0	0%	1	3%
Biology	1	5%	0	0%	0	0%	0	0%
Chemistry	1	5%	0	0%	0	0%	0	0%

5. Please indicate which science and math courses you ***plan to take*** at school in the future.

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No Answer	0	0%	0	0%	1	9%	0	0%
Grade 10								
Consumer	1	5%	6	17%	0	0%	7	21%
Pre-Cal	1	5%	1	3%	1	9%	0	0%
Science	1	5%	8	22%	1	9%	10	30%
Grade 11								
Consumer	10	50%	25	69%	2	18%	19	58%
Pre-Cal	9	45%	12	33%	8	73%	15	45%
Biology	18	90%	30	83%	7	64%	20	61%
Chemistry	11	55%	22	61%	7	64%	15	45%
Physics	6	30%	7	19%	5	45%	12	36%
Computer Science	0	0%	2	6%	2	18%	4	12%

6. What are your three most favorite subjects in high school?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
#1								
Science	2	10%	6	17%	0	0%	1	3%
Math	9	45%	2	6%	1	9%	5	15%
English	7	35%	9	25%	1	9%	1	3%
Social Studies	0	0%	2	6%	1	9%	5	15%
Performing Arts	1	5%	4	11%	4	36%	2	6%
Gym	0	0%	8	22%	2	18%	10	30%
TAA	0	0%	4	11%	0	0%	4	12%
Other	1	5%	1	3%	1	9%	3	9%
No Answer	0	0%	1	3%	0	0%	1	3%
#2								
Science	7	35%	9	25%	2	18%	11	33%
Math	3	15%	6	17%	2	18%	6	18%
English	1	5%	6	17%	0	0%	2	6%
Social Studies	2	10%	2	6%	1	9%	1	3%
Performing Arts	5	25%	2	6%	4	36%	4	12%
Gym	1	5%	2	6%	1	9%	3	9%
TAA	3	15%	5	14%	0	0%	4	12%
Other	0	0%	2	6%	1	9%	3	9%
No Answer	0	0%	3	8%	0	0%	1	3%
#3								
Science	5	25%	3	8%	0	0%	5	15%
Math	1	5%	4	11%	1	9%	5	15%
English	2	10%	2	6%	1	9%	5	15%
Social Studies	1	5%	5	14%	1	9%	3	9%
Performing Arts	2	10%	10	28%	2	18%	2	6%
Gym	3	15%	4	11%	3	27%	1	3%
TAA	1	5%	5	14%	1	9%	7	21%
Other	2	10%	2	6%	2	18%	2	6%
No Answer	0	0%	2	6%	0	0%	3	9%
Cumulative Results								
Science	14	23%	18	17%	2	6%	17	17%
Math	13	22%	12	11%	4	12%	16	16%
English	10	17%	17	16%	2	6%	8	8%
Social Studies	3	5%	9	8%	3	9%	9	9%
Performing Arts	8	13%	16	15%	10	30%	8	8%
Gym	4	7%	14	13%	6	18%	14	14%
TAA	4	7%	14	13%	1	3%	15	15%
Other	3	5%	5	5%	4	12%	8	8%
No Answer	0	0%	6	6%	0	0%	5	5%

7. What are your three least favorite subjects in high school?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
#1								
Science	5	25%	7	19%	2	18%	7	21%
Math	7	35%	18	50%	3	27%	12	36%
English	3	15%	6	17%	1	9%	5	15%
Social Studies	4	20%	1	3%	5	45%	3	9%
Performing Arts	1	5%	1	3%	1	9%	0	0%
Gym	0	0%	3	8%	0	0%	0	0%
TAA	0	0%	0	0%	0	0%	2	6%
Other	1	5%	0	0%	1	9%	0	0%
No Answer	0	0%	1	3%	0	0%	4	12%
#2								
Science	5	25%	15	42%	3	27%	9	27%
Math	1	5%	7	19%	3	27%	3	9%
English	1	5%	4	11%	2	18%	5	15%
Social Studies	7	35%	6	17%	1	9%	6	18%
Performing Arts	0	0%	2	6%	0	0%	0	0%
Gym	3	15%	2	6%	1	9%	1	3%
TAA	1	5%	1	3%	0	0%	0	0%
Other	0	0%	0	0%	0	0%	3	9%
No Answer	0	0%	2	6%	0	0%	6	18%
#3								
Science	2	10%	4	11%	0	0%	1	3%
Math	2	10%	1	3%	2	18%	3	9%
English	3	15%	5	14%	2	18%	5	15%
Social Studies	3	15%	9	25%	1	9%	4	12%
Performing Arts	1	5%	3	8%	0	0%	3	9%
Gym	2	10%	5	14%	0	0%	1	3%
TAA	1	5%	0	0%	1	9%	1	3%
Other	0	0%	2	6%	2	18%	1	3%
No Answer	0	0%	6	17%	1	9%	11	33%
Cumulative Results								
Science	12	20%	26	24%	5	15%	17	17%
Math	10	17%	26	24%	8	24%	18	18%
English	7	12%	15	14%	5	15%	15	15%
Social Studies	14	23%	16	15%	7	21%	13	13%
Performing Arts	2	3%	6	6%	1	3%	3	3%
Gym	5	8%	10	9%	1	3%	2	2%
TAA	2	3%	1	1%	1	3%	3	3%
Other	1	2%	2	2%	3	9%	4	4%
No Answer	0	0%	9	8%	1	3%	21	21%

8. When I graduate from high school, I plan to:

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
To Work	1	5%	3	8%	1	9%	8	24%
College	4	20%	12	33%	1	9%	12	36%
University	15	75%	21	58%	9	82%	13	39%
No Answer	0	0%	0	0%	0	0%	0	0%

9. Please state the field of study you plan to enter at University/College:

University	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Engineer	0	0%	0	0%	2	18%	1	3%
Medicine	4	20%	1	3%	4	36%	3	9%
Nursing	4	20%	4	11%	0	0%	0	0%
Vetrinary	1	5%	0	0%	0	0%	0	0%
Dentistry	1	5%	3	8%	0	0%	0	0%
Pharmacy	0	0%	3	8%	0	0%	0	0%
Dental Hygenist	1	5%	0	0%	0	0%	0	0%
Forensics	0	0%	1	3%	0	0%	0	0%
Computer Science	0	0%	1	3%	1	9%	0	0%
Math/Science	0	0%	0	0%	0	0%	1	3%
Total Science/Math	11	55%	13	36%	5	45%	4	12%
Education	3	15%	4	11%	0	0%	0	0%
Music	0	0%	0	0%	4	36%	1	3%
Counseling	0	0%	3	8%	0	0%	0	0%
Social Work	0	0%	1	3%	0	0%	0	0%
Psychology	0	0%	2	6%	0	0%	1	3%
Fine Arts	0	0%	0	0%	0	0%	1	3%
Culinary Arts	0	0%	1	3%	0	0%	0	0%
Law	0	0%	1	3%	0	0%	0	0%
Journalism	0	0%	0	0%	0	0%	0	0%
Radio	0	0%	1	3%	0	0%	0	0%
Business	0	0%	0	0%	0	0%	1	3%
Accounting	0	0%	0	0%	0	0%	1	3%
Total Arts	3	15%	13	36%	4	36%	5	15%
Don't Know	3	15%	0	0%	0	0%	2	6%
No Answer	2	10%	0	0%	1	9%	2	6%
Not Sure	0	0%	1	3%	0	0%	0	0%

9. Please state the field of study you plan to enter at University/College:

College	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Engineer	0	0%	0	0%	0	0%	0	0%
Nursing	1	5%	0	0%	0	0%	0	0%
Psychology	1	5%	1	3%	0	0%	0	0%
Automotive	0	0%	0	0%	1	9%	0	0%
Criminolgy	0	0%	1	3%	0	0%	0	0%
Culinary Arts	2	10%	0	0%	0	0%	1	3%
Beauty School	1	5%	0	0%	0	0%	0	0%
Real Estate	0	0%	1	3%	0	0%	0	0%
Accounting	0	0%	3	8%	0	0%	0	0%
Business	0	0%	1	3%	0	0%	0	0%
Fashion	0	0%	1	3%	0	0%	0	0%
Military College	0	0%	0	0%	0	0%	1	3%
Radio Hosting	0	0%	0	0%	0	0%	1	3%
Fire Fighting	0	0%	0	0%	0	0%	1	3%
Don't Know	0	0%	4	11%	0	0%	1	3%
No Answer	0	0%	1	3%	0	0%	4	12%

10. When you go to University/College, do you intend to take any courses in the following disciplines.

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Physics	7	35%	5	14%	4	36%	9	27%
Computer Science	5	25%	3	8%	1	9%	4	12%
Engineering	0	0%	0	0%	4	36%	7	21%
Astronomy	1	5%	1	3%	2	18%	3	9%
Math	8	40%	16	44%	5	45%	10	30%
Biology	12	60%	16	44%	6	55%	10	30%
Chemistry	11	55%	15	42%	6	55%	7	21%
No Answers	0	0%	9	25%	4	36%	7	21%

11. Please indicate the career you would like to do after graduating from:

University	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Engineer	0	0%	0	0%	2	18%	1	3%
Doctor	3	15%	0	0%	4	36%	3	9%
Nurse	4	20%	5	14%	0	0%	1	3%
Vetrinarian	1	5%	0	0%	0	0%	0	0%
Dentist	1	5%	2	6%	0	0%	0	0%
Dental Hygenist	1	5%	1	3%	0	0%	0	0%
Pharmacist	0	0%	0	0%	1	9%	0	0%
Pharmacy Tech	0	0%	0	0%	0	0%	1	3%
Psychologist	0	0%	1	3%	0	0%	0	0%
Astronomer	1	5%	0	0%	0	0%	0	0%
Marine Biologist	1	5%	0	0%	0	0%	0	0%
C.S.I.	0	0%	1	3%	0	0%	0	0%
Total Science	12	60%	10	28%	5	45%	5	15%
Teacher	3	15%	4	11%	3	27%	1	3%
Police	0	0%	0	0%	0	0%	1	3%
Business	0	0%	0	0%	1	9%	0	0%
Game Designer	0	0%	0	0%	0	0%	1	3%
Counseling	0	0%	2	6%	0	0%	0	0%
Radio	0	0%	1	3%	0	0%	0	0%
Social Worker	0	0%	1	3%	0	0%	0	0%
Lawyer	0	0%	1	3%	0	0%	0	0%
Journalist	0	0%	1	3%	0	0%	0	0%
Pastry Chef	0	0%	1	3%	0	0%	0	0%
Actor	0	0%	0	0%	0	0%	1	3%
Graphic Designer	0	0%	0	0%	0	0%	1	3%
Architect	0	0%	0	0%	0	0%	1	3%
Construction	0	0%	0	0%	0	0%	1	3%
Flight Attendant	0	0%	0	0%	0	0%	1	3%
Total Arts	3	15%	11	31%	4	36%	8	24%
Don't know	1	5%	0	0%	0	0%	1	3%
No Answer	1	5%	2	6%	1	9%	1	3%

11. Please indicate the career you would like to do after graduating from University/College:

College	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Engineer	0	0%	0	0%	0	0%	0	0%
Nurse	1	5%	0	0%	0	0%	1	3%
Computer Tech.	0	0%	0	0%	0	0%	2	6%
Auto Mechanic	0	0%	0	0%	1	9%	2	6%
Real Estate	0	0%	2	6%	0	0%	0	0%
Accounting	0	0%	3	8%	0	0%	0	0%
Fashion	0	0%	1	3%	0	0%	0	0%
Inmate Counselor	0	0%	1	3%	0	0%	0	0%
Work In Office	0	0%	1	3%	0	0%	0	0%
Architect	0	0%	0	0%	0	0%	1	3%
Basic Infantry	0	0%	0	0%	0	0%	1	3%
Radio Host	0	0%	0	0%	0	0%	1	3%
Psychologist	1	5%	1	3%	0	0%	0	0%
Therapist	1	5%	0	0%	0	0%	0	0%
Chef	2	10%	0	0%	0	0%	1	3%
Fire Fighting	0	0%	0	0%	0	0%	1	3%
Make up Artist	1	5%	0	0%	0	0%	0	0%
Not Sure	0	0%	3	8%	0	0%	2	6%
No Answer	0	0%	0	0%	0	0%	1	3%

12. Please state the occupation you plan to work at after graduating from high school:

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
KGS (Eng. Firm)	1	5%	0	0%	0	0%	0	0%
Cashier	0	0%	1	3%	0	0%	1	3%
Health Care Aide	0	0%	1	3%	0	0%	0	0%
Comic Book Maker	0	0%	0	0%	0	0%	1	3%
Taxi Driver	0	0%	0	0%	0	0%	1	3%
Culinary Arts	0	0%	0	0%	0	0%	1	3%
Drama Teacher	0	0%	1	3%	0	0%	0	0%
Don't Know	0	0%	0	0%	0	0%	1	3%
No Answer	0	0%	0	0%	1	9%	3	9%

13. Please indicate all activities that you are involved with at school

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Basketball	2	10%	4	11%	0	0%	6	18%
Volleyball	2	10%	2	6%	2	18%	2	6%
Indoor Track	1	5%	1	3%	0	0%	1	3%
Outdoor Track	1	5%	1	3%	1	9%	4	12%
Badminton	0	0%	3	8%	1	9%	2	6%
Indoor Soccer	0	0%	0	0%	0	0%	1	3%
Outdoor Soccer	0	0%	2	6%	1	9%	3	9%
Cross Country	0	0%	1	3%	0	0%	1	3%
Football	0	0%	0	0%	3	27%	6	18%
Hockey	0	0%	0	0%	1	9%	4	12%
Baseball	0	0%	0	0%	0	0%	2	6%
Kangaball	0	0%	0	0%	1	9%	2	6%
Unity Group	4	20%	0	0%	0	0%	1	3%
SWAT	1	5%	0	0%	0	0%	0	0%
Student Council	2	10%	1	3%	1	9%	0	0%
MSLC	1	5%	0	0%	0	0%	0	0%
YMCA Exchange	1	5%	1	3%	0	0%	0	0%
Amnesty	0	0%	0	0%	1	9%	0	0%
CUB	0	0%	0	0%	0	0%	1	3%
Band	2	10%	0	0%	9	82%	1	3%
Choir	1	5%	6	17%	1	9%	1	3%
Vocal Jazz	0	0%	0	0%	0	0%	1	3%
Drama	2	10%	6	17%	1	9%	1	3%
Dance	0	0%	0	0%	0	0%	2	6%
No Answer	7	35%	15	42%	4	36%	14	42%
Number of Activities								
1	8	40%	15	42%	1	9%	11	33%
2	3	15%	5	14%	2	18%	3	9%
3	0	0%	0	0%	2	18%	2	6%
4	1	5%	1	3%	2	18%	1	3%
5	1	5%	0	0%	1	9%	1	3%

14. Please indicate all activities that you are involved with outside of school (ex. Dance group, volunteering)

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Gymnastics	1	5%	0	0%	0	0%	0	0%
Baseball	1	5%	2	6%	0	0%	0	0%
Basketball	2	10%	0	0%	2	18%	4	12%
Soccer	0	0%	2	6%	1	9%	4	12%
Martial Arts	0	0%	2	6%	0	0%	0	0%
Hockey	0	0%	0	0%	0	0%	3	9%
Football	0	0%	0	0%	0	0%	1	3%
Volleyball	0	0%	0	0%	0	0%	1	3%
Curling	0	0%	0	0%	0	0%	1	3%
Volunteer	7	35%	21	58%	3	27%	7	21%
Band	0	0%	0	0%	2	18%	0	0%
Piano	0	0%	1	3%	1	9%	0	0%
Dance Group	3	15%	3	8%	0	0%	2	6%
Drama	0	0%	0	0%	0	0%	1	3%
Choir	0	0%	0	0%	0	0%	1	3%
Work	1	5%	5	14%	0	0%	2	6%
No Answer	6	30%	6	17%	4	36%	11	33%
Number of Activities								
1	9	45%	22	61%	6	55%	16	48%
2	0	0%	4	11%	2	18%	3	9%
3	1	5%	1	3%	0	0%	1	3%
4	0	0%	0	0%	0	0%	0	0%
5	0	0%	0	0%	0	0%	0	0%
Both	9	45%	18	50%	6	55%	16	48%
None	4	20%	2	6%	0	0%	4	12%

15. The following family members have a university or college degree (please identify the field of study):

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Mother								
Engineer	0	0%	1	3%	1	9%	1	3%
Nurse	2	10%	4	11%	0	0%	4	12%
Teacher	1	5%	1	3%	1	9%	1	3%
Dentist	0	0%	0	0%	1	9%	0	0%
Law	0	0%	1	3%	0	0%	0	0%
Medical	1	5%	0	0%	0	0%	0	0%
Pharmacy	0	0%	1	3%	0	0%	0	0%
Science	0	0%	0	0%	0	0%	1	3%
Microbiologist	0	0%	0	0%	1	9%	0	0%
Electronics	0	0%	0	0%	0	0%	1	3%
Accounting	0	0%	0	0%	0	0%	1	3%
Bachelor of Arts	0	0%	1	3%	0	0%	0	0%
Daycare	0	0%	0	0%	0	0%	1	3%
Business	0	0%	0	0%	1	9%	0	0%
Secretarial	0	0%	3	8%	0	0%	0	0%
Wildlife	0	0%	1	3%	0	0%	0	0%
Social Work	0	0%	1	3%	0	0%	0	0%
Beautician	1	5%	0	0%	0	0%	0	0%
Unknown	2	10%	6	17%	0	0%	3	9%
No Answer	3	15%	0	0%	1	9%	0	0%
Total	10	50%	19	53%	6	55%	13	39%
Father								
Engineer	3	15%	3	8%	1	9%	2	6%
Medicine	0	0%	1	3%	0	0%	0	0%
Aviation	1	5%	0	0%	0	0%	0	0%
Nurse	0	0%	0	0%	0	0%	1	3%
Science	0	0%	0	0%	0	0%	1	3%
Criminology	0	0%	1	3%	0	0%	0	0%
Surveyor	0	0%	0	0%	0	0%	1	3%
Accounting	0	0%	1	3%	1	9%	2	6%
Bachelor of Arts	0	0%	1	3%	0	0%	0	0%
Business	1	5%	0	0%	0	0%	1	3%
Carpenter	0	0%	1	3%	0	0%	0	0%

15. Continued								
Welder	0	0%	0	0%	0	0%	1	3%
Agriculture	0	0%	1	3%	0	0%	0	0%
Computers	0	0%	1	3%	0	0%	0	0%
Electrician	0	0%	1	3%	1	9%	0	0%
Unknown	3	15%	5	14%	0	0%	3	9%
No Answer	3	15%	0	0%	1	9%	0	0%
Total	11	55%	16	44%	4	36%	12	36%
	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Sister								
Dental Hygenist	1	5%	0	0%	0	0%	0	0%
Dentistry	0	0%	0	0%	1	9%	0	0%
Pharmacy	0	0%	0	0%	1	9%	0	0%
Health Care	1	5%	0	0%	0	0%	0	0%
Pharmacy Tech	0	0%	1	3%	0	0%	0	0%
Nurse	1	5%	0	0%	0	0%	0	0%
Computer Tech	0	0%	0	0%	0	0%	1	3%
Teacher	0	0%	0	0%	0	0%	1	3%
Tourism	0	0%	1	3%	0	0%	0	0%
Law	1	5%	0	0%	0	0%	0	0%
Business	1	5%	0	0%	0	0%	1	3%
Unknown	1	5%	0	0%	0	0%	0	0%
No Answer	0	0%	0	0%	0	0%	0	0%
Total	6	30%	2	6%	0	0%	3	9%
Brother								
Engineering	1	5%	0	0%	0	0%	0	0%
Nurse	0	0%	1	3%	0	0%	1	3%
Science	1	5%	0	0%	0	0%	0	0%
Pharmacy	0	0%	1	3%	0	0%	0	0%
Aviation	0	0%	1	3%	0	0%	0	0%
Computer Tech	0	0%	0	0%	0	0%	1	3%
Teacher	0	0%	0	0%	0	0%	1	3%
Criminal Justice	0	0%	0	0%	1	9%	0	0%
Business Admin.	0	0%	1	3%	0	0%	0	0%
Welding	1	5%	0	0%	0	0%	0	0%
Carpenter	0	0%	0	0%	0	0%	0	0%
Mechanic	1	5%	0	0%	0	0%	0	0%

15. Continued								
Unknown	1	5%	0	0%	0	0%	0	0%
Total	5	25%	4	11%	0	0%	3	9%
Total Family								
1	5	25%	7	19%	2	18%	9	27%
2	9	45%	7	19%	5	45%	6	18%
3	0	0%	4	11%	0	0%	2	6%
4	1	5%	1	3%	0	0%	1	3%
No Answer	5	25%	15	42%	3	27%	15	45%

16. Do you get help with your science homework at home?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	12	60%	27	75%	8	73%	23	70%
Yes	8	40%	9	25%	3	27%	10	30%
Who?								
Mother	4	20%	3	8%	3	27%	8	24%
Father	4	20%	3	8%	2	18%	3	9%
Sister	4	20%	1	3%	0	0%	1	3%
Brother	2	10%	3	8%	0	0%	1	3%
Other	0	0%	3	8%	0	0%	0	0%
No Answer	1	5%	0	0%	0	0%	0	0%
Total	15	75%	13	36%	0	0%	13	39%
Number of Family								
1	3	15%	6	17%	0	0%	7	21%
2	3	15%	2	6%	2	18%	3	9%
3	0	0%	1	3%	0	0%	0	0%
4	1	5%	0	0%	0	0%	0	0%

17. How often do you watch scientific television programs or documentaries related to space topics?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	0	0%	0	0%	2	18%	2	6%
Frequently	5	25%	5	14%	4	36%	8	24%
Seldom	7	35%	18	50%	3	27%	11	33%
Never	7	35%	13	36%	3	27%	12	36%
No Answer	1	5%	0	0%	0	0%	0	0%

Female Yes Comments	
Space Channel (2)	Not interested (7)
Discovery (3)	Boring (2)
Mythbusters (1)	No time (1)
Guinea Pig (1)	Documentaries (1)
Female No Comments	
National Geo (1)	Don't like watching (1)
Geography (2)	Usually watch shows about animals
Futurama (1)	Parents control TV
Discovery (4)	Science doesn't hold my interest too good
Boring (6)	Something better on
Not interested (7)	Rarely watch TV
No cable	No time
Male Yes Comments	
Discovery (3)	Does not peak my interest
Nova (1)	Barely watch TV
Star Trek (1)	I don't get interested by those kind of shows
NASA (1)	Not on TV
Countdown to Mars (1)	
Male No Comments	
Discovery (4)	If I need to know about it
Mythbusters (1)	Does not interest me (3)
NASA (1)	Don't have channels (1)
National Geo. (1)	Never on TV (1)
Space Channel (2)	Its dumb (1)
Boring (7)	Don't like it (2)
Fallasleep watching (1)	

18. Does anyone else at home watch scientific television programs or documentaries related to space topics?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	14	70%	21	58%	4	36%	26	79%
Yes	6	30%	15	42%	7	64%	6	18%
No Answer	0	0%	0	0%		0%	1	3%

Female Yes Comments	
Discovery (1)	Brother (3)
Guinea Pig (1)	Mom (1)
Mythbusters (1)	Dad (1)
Space Channel (1)	

Female No Comments	
Discovery (7)	Dad (6)
Futurama (1)	Mom (2)
How its made (1)	Brother (2)
Mythbusters (1)	Roommate
Geography (1)	TLC (1)

Male Yes Comments	
Dad (3)	National Geographic (1)
Mom (1)	Discovery (2)
Grandpa (1)	Space (1)

Male No Comments	
Brother (4)	
Mom (2)	
Sister (1)	Mythbusters (1)
Dad (3)	Discovery (2)
Don't know (2)	Don't have channels (1)

19. How often do you read a scientific article related to space in the printed press (ex. Newspaper, magazine)?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	0	0%	0	0%	1	9%	0	0%
Frequently	1	5%	1	3%	1	9%	3	9%
Seldom	8	40%	12	33%	4	36%	10	30%
Never	11	55%	23	64%	4	36%	21	64%
No Answer	0	0%	0	0%	1	9%	0	0%

Female Yes Comments	
Newspaper (2)	Too busy
Magazine (2)	Boring (1)
Not interested (6)	Not sure (1)
Whatever I see (2)	
No access (1)	
A little interested but I don't spend the effort to search it up or anything like that	
I don't really read the paper or magazines that would talk about this stuff	

Female No Comments	
Not interested (9)	Articles my teacher hands out
Boring (2)	Never really see them
Magazine (1)	Not into science that much
I am not into that	I read them in science class for an article assignment
Whatever I find	Because its boring to read
I don't like to read (2)	

Male Yes Comments	
Discover (1)	I've never had or have seen any
NASA (1)	It's just interesting to me
Comic Books (1)	Astronomy doesn't interest me as much as biology
Earthfiles.com (1)	Never came across it
National Geo (1)	I don't like reading articles like that
Boring (1)	

19. Continued		
Male No Comments		
National Geo (1)	Don't like reading (1)	Does not relate to me
Textbook (1)	Because I don't (2)	Never appeals to me
Magazine (2)	Not interested (5)	
Don't like it (1)	I want to know daily happenings	
Don't have time (1)	Don't care for them (1)	
The internet (1)	Boring (8)	

20. Does anyone in your home read scientific articles related to space in the printed press (ex. Newspaper, magazine)?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	12	60%	28	78%	9	82%	25	76%
Yes	7	35%	6	17%	1	9%	6	18%
No Answer		0%	2	6%	1	9%	1	3%

Female Yes Comments	
Newspapers (7)	
Father (2)	
Brother (2)	
Female No Comments	
Dad (2)	Dad reads a lot of knowledge things
Mom (1)	Newspapers
Grandfather	
Male No Comments	
Brother	Internet
Mom (1)	Magazines
Dad (1)	Newspapers

21. How often do you surf Internet sites related to space topics?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	1	5%	1	3%	1	9%	2	6%
Frequently	2	10%	2	6%	2	18%	3	9%
Seldom	9	45%	11	31%	4	36%	10	30%
Never	8	40%	20	56%	4	36%	15	45%
No Answer	0	0%	0	0%	0	0%	3	9%

Female Yes Comments
Not interested (3) Don't spend effort (1) For homework only (2) I'm not a nerd when I'm at home and I go on the computer I go on Facebook and stuff like that

Female No Comments	
Not interested (6)	Space doesn't catch my interest to actually surf on it
Boring (2)	Because I have textbooks for it
Don't like space	No interest at home
I had no time	Don't care for space
It's not fun	Waste of time unless its for homework I do
Not on internet much	Only when I have a project

Male Yes Comments
Don't feel like it I never see any space/science related things while browsing the internet Boring I don't go on the computer that much

Male No Comments	
Because I don't	It doesn't appeal to me
Not interested (5)	Cause I'm not a loser
No computer (2)	I go on Facebook

22. Does anyone in your home surf Internet sites related to space topics?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	17	85%	33	92%	9	82%	28	85%
Yes	3	15%	3	8%	1	9%	4	12%
No Answer	0	0%	0	0%	1	9%	1	3%
Female Yes Comments								
Brother (1) Dad (1)	Youtube (2)							
Female No Comments								
Mom (1) Brother (1)	Only when they have a project							
Male No Comments								
Unknown (1) For Homework	No - my family is cool							

23. Do you do science related activities outside your home with your family? (ex. Planetarium, science museum)

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
No	11	55%	30	83%	8	73%	29	88%
Yes	9	45%	5	14%	3	27%	3	9%
No Answer	0	0%	1	3%	0	0%	1	3%

Female Yes Comments
Planetarium (4)
Touch the Universe (6) Science City (1) NY Science Museum (1) Science Fairs (1)
Female No Comments
Manitoba Museum (2) Planetarium (3)
Male Yes Comments
Science Museum (1) Manitoba Museum (2) Planetarium (1)
Male No Comments
Manitoba Museum (1) Planetarium (1)

24. How often do you go to the theatre to watch science fiction movies about space and space related topics?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Always	0	0%	0	0%	1	9%	2	6%
Frequently	0	0%	0	0%	1	9%	2	6%
Seldom	10	50%	8	22%	4	36%	13	39%
Never	10	50%	28	78%	5	45%	15	45%
No Answer	0	0%	0	0%	0	0%	1	3%

Female Yes Comments	
Don't go to movies (2)	
Not interested (5)	
Boring (1)	

Female No Comments	
There stupid (1)	Because we don't go
Have no time (2)	that's not my thing
Don't like it (1)	I am not sure I like it
Boring (3)	We would rather watch Disney/action movies
Not interested (9)	I like funny movies
Don't know (1)	

Male Yes Comments
Not interesting (2)
Don't know (1)
It has lots of action and future predictions
I cant follow the way those kinds of movies are showed
Theres none to watch

Male No Comments	
Not allowed (2)	Because I don't (1)
Don't care (1)	We don't have the money to take all 8 of us to places
Boring (3)	Because we rather go watch some good movies
Not interested (2)	

25. What three courses are your closest friends' most favorite subjects in high school?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
#1								
Science	0	0%	4	11%	0	0%	3	9%
Math	7	35%	5	14%	3	27%	1	3%
English	3	15%	5	14%	0	0%	0	0%
Social Studies	0	0%	1	3%	0	0%	2	6%
Performing Arts	1	5%	6	17%	1	9%	4	12%
Gym	7	35%	6	17%	6	55%	10	30%
TAA	0	0%	1	3%	0	0%	4	12%
Other	1	5%	5	14%	1	9%	2	6%
No Answer	1	5%	4	11%	0	0%	7	21%
#2								
Science	3	15%	6	17%	2	18%	7	21%
Math	2	10%	4	11%	2	18%	3	9%
English	4	20%	9	25%	1	9%	0	0%
Social Studies	1	5%	2	6%	0	0%	1	3%
Performing Arts	1	5%	4	11%	1	9%	4	12%
Gym	4	20%	1	3%	2	18%	2	6%
TAA	2	10%	4	11%	1	9%	4	12%
Other	0	0%	1	3%	0	0%	2	6%
No Answer	3	15%	4	11%	0	0%	8	24%
#3								
Science	1	5%	7	19%	2	18%	2	6%
Math	2	10%	2	6%	0	0%	2	6%
English	2	10%	4	11%	2	18%	5	15%
Social Studies	0	0%	1	3%	0	0%	3	9%
Performing Arts	3	15%	6	17%	2	18%	5	15%
Gym	5	25%	4	11%	2	18%	0	0%
TAA	2	10%	5	14%	3	27%	4	12%
Other	1	5%	3	8%	1	9%	4	12%
No Answer	4	20%	4	11%	0	0%	8	24%
Cumulative Results								
Science	4	7%	17	16%	4	12%	12	12%
Math	11	18%	11	10%	5	15%	6	6%
English	9	15%	18	17%	3	9%	5	5%
Social Studies	1	2%	4	4%	0	0%	6	6%
Performing Arts	5	8%	16	15%	4	12%	13	13%
Gym	16	27%	11	10%	10	30%	12	12%
TAA	4	7%	10	9%	4	12%	12	12%
Other	2	3%	9	8%	2	6%	8	8%
No Answer	8	13%	12	11%	0	0%	23	23%

26. What three courses are your closest friends' least favorite subjects in high school?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
#1								
Science	1	5%	2	6%	2	18%	8	24%
Math	9	45%	14	39%	6	55%	8	24%
English	5	25%	8	22%	1	9%	2	6%
Social Studies	4	20%	2	6%	2	18%	3	9%
Performing Arts	0	0%	3	8%	1	9%	1	3%
Gym	0	0%	3	8%	1	9%	2	6%
TAA	0	0%	0	0%	0	0%	1	3%
Other	0	0%	1	3%	0	0%	0	0%
No Answer	1	5%	3	8%	0	0%	10	30%
#2								
Science	12	60%	9	25%	3	27%	6	18%
Math	1	5%	7	19%	0	0%	4	12%
English	0	0%	0	0%	2	18%	3	9%
Social Studies	2	10%	9	25%	5	45%	3	9%
Performing Arts	2	10%	2	6%	0	0%	0	0%
Gym	1	5%	3	8%	0	0%	3	9%
TAA	1	5%	0	0%	0	0%	1	3%
Other	1	5%	1	3%	1	9%	1	3%
No Answer	2	10%	3	8%	0	0%	12	36%
#3								
Science	2	10%	9	25%	5	45%	1	3%
Math	1	5%	3	8%	3	27%	3	9%
English	3	15%	1	3%	1	9%	4	12%
Social Studies	2	10%	10	28%	1	9%	3	9%
Performing Arts	3	15%	0	0%	0	0%	0	0%
Gym	1	5%	2	6%	0	0%	3	9%
TAA	1	5%	2	6%	1	9%	2	6%
Other	0	0%	3	8%	0	0%	2	6%
No Answer	5	25%	4	11%	0	0%	15	45%
Cumulative Results								
Science	15	25%	20	19%	10	30%	15	15%
Math	11	18%	24	22%	9	27%	15	15%
English	8	13%	9	8%	4	12%	9	9%
Social Studies	8	13%	21	19%	8	24%	9	9%
Performing Arts	5	8%	5	5%	1	3%	1	1%
Gym	2	3%	8	7%	1	3%	8	8%
TAA	2	3%	2	2%	1	3%	4	4%
Other	1	2%	5	5%	1	3%	3	3%
No Answer	8	13%	10	9%	0	0%	37	37%

27. List your three favorite topics relating to space

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
#1								
Astronomy	1	5%	7	19%	2	18%	5	15%
Planetary Geology	3	15%	8	22%	1	9%	4	12%
Extraterrestrials	2	10%	3	8%	0	0%	2	6%
Physics	2	10%	4	11%	4	36%	1	3%
Biology	1	5%	0	0%	1	9%	1	3%
Astrology	0	0%	1	3%	0	0%	0	0%
No Answer	11	55%	13	36%	4	36%	20	61%
#2								
Astronomy	2	10%	7	19%	3	27%	4	12%
Planetary Geology	2	10%	6	17%	1	9%	2	6%
Extraterrestrials	0	0%	2	6%	0	0%	3	9%
Physics	1	5%	2	6%	1	9%	1	3%
Biology	3	15%	2	6%	0	0%	1	3%
Astrology	0	0%	0	0%	1	9%	0	0%
No Answer	12	60%	17	47%	4	36%	21	64%
#3								
Astronomy	2	10%	7	19%	1	9%	4	12%
Planetary Geology	1	5%	5	14%	1	9%	3	9%
Extraterrestrials	1	5%	2	6%	0	0%	0	0%
Physics	1	5%	2	6%	1	9%	1	3%
Biology	2	10%	1	3%	2	18%	0	0%
Astrology	0	0%	1	3%	0	0%	0	0%
No Answer	13	65%	19	53%	5	45%	25	76%
Cumulative Results								
Astronomy	5	8%	21	19%	6	18%	13	13%
Planetary Geology	6	10%	19	18%	3	9%	9	9%
Extraterrestrials	3	5%	7	6%	0	0%	5	5%
Physics	4	7%	8	7%	6	18%	3	3%
Biology	6	10%	3	3%	3	9%	2	2%
Astrology	0	0%	2	2%	1	3%	0	0%
No Answer	36	60%	49	45%	13	39%	66	67%

28. How much importance do you feel has been given to space and space-related topics, in the context of your early and middle school education?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
A lot	1	5%	1	3%	0	0%	0	0%
Some	10	50%	21	58%	2	18%	11	33%
A little	8	40%	10	28%	7	64%	11	33%
Nothing	0	0%	3	8%	1	9%	11	33%
No Answer	1	5%	1	3%	1	9%	0	0%

29. How much importance do you feel has been given to space and space-related topics, in the context of your high-school education?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
A lot	3	15%	1	3%	0	0%	0	0%
Some	9	45%	14	39%	4	36%	11	33%
A little	6	30%	15	42%	4	36%	9	27%
Nothing	1	5%	5	14%	2	18%	13	39%
No Answer	1	5%	1	3%	1	9%	0	0%

30. Have you ever heard of the WinCube Project at your school?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	9	45%	5	14%	4	36%	7	21%
No	11	55%	30	83%	7	64%	26	79%
No Answer	0	0%	1	3%	0	0%	0	0%

31. Have you ever participated in the WinCube Project at your school?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	0	0%	0	0%	0	0%	0	0%
No	9	45%	5	14%	4	36%	7	21%
No Answer	0	0%	0	0%	0	0%	0	0%

32 - 36. Based on the description of the *"Activity"*, would you ever consider joining this component of the WinCube Project?

CubeSat	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	12	60%	5	14%	5	45%	4	12%
No	8	40%	31	86%	6	55%	28	85%
No Answer	0	0%	0	0%	0	0%	1	3%

Female Yes Comments
Not interested (1) Interesting (2)
Because I want to learn more about it and it seems very exciting.
Sounds like it would be a great experience. It sounds cool, just interests me.
No because I am not good at science and also I am not interested.
I am not interested in that kind of stuff. It's interesting but I cant commit to it.
I wouldn't want to because it doesn't really give me benefits for what I want to do in the future.
I choose no because I'm not really into scientific things.
Don't have the time right now.
I'm not interested in science and it is not one of my strong subjects.
I'm not interested in aerospace, and I would not want to spend my time learning about.
WinCube doesn't not sound interesting to me.
Female No Comments
Not interested (11) Science isn't my thing. Sounds interesting.
Don't want to (1) It does sound kind of interesting.
It does not seem like something I would like. Not interested in aerospace.
Better things to do. Because it's really interesting.
It seems to be pretty interesting. It does sound kind of interesting.
I have some other works to do. I am not really into science.
I am not really into building stuff and learning about space related things.
I would get really bored fast. I'm not interested in space engineering.
It seems like a good experience for people to learn from.
Male Yes Comments
Interesting (1) I want to be the next guy to build a rocket and fly to Pluto.
No time (2)
I don't like doing things like that. Seems like a great adventure.
No one thinks science is cool, so as far as they know I don't either.
Hands on projects really interest me, and anything in the field of science interests me.
No - Everyting gets more complicated/complex as you start to know more about it.

CubeSat Continued

Male No Comments	
	Waste of time
No time (4)	(1)
Not interested (7)	Better things to do (1)
Sounds interesting (1)	Because this sort of stuff does not appeal to my mind.
	Seems like something I just
Working (1)	wouldn't do.
	I don't like
Boring (2)	space.

BCube	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	12	60%	2	6%	5	45%	5	15%
No	8	40%	34	94%	6	55%	28	85%
No Answer	0	0%	0	0%	0	0%	0	0%

Female Yes Comments

Not interesting (4)   It sounds interesting.
Exciting (1)   Sounds cool and a neat way to learn.
Because it seems interesting.   But I wouldn't be able to commit.
I choose no because I don't really like space it means to me that there is only more things
to learn about.   Don't have the time right now.
Because they all fit on what I want to try.
It sounds pretty fun to launch things into the atmosphere.

Female No Comments

Boring (1)   (yes) because I'd like to do tracking when in flight be on a mission.
Not interested (10)   (yes) because I think its going to be so fun doing this project.
Don't know (1)   It does not seem like something I would like.
Don't want to (1)   I am not really into science.
Lazy (1)   I don't believe that I'm capable of building anything.
It involves too much experimenting for me.   I don't feel like its fun.
Not into science.   (No) - obvious reasons.
I'm not interested in science!   I would not like it and get bored.
Not my place of interest, sorry.   I don't like this kind of stuff.
I don't care about things that go on in aerospace industry and I don't want to spend my time learning about it.

Male Yes Comments

Not interested (1)   No - to much work - could equal a fail.
Interesting (1)   It would seem fun to do that sort of thing.
No time (1)   Like I said science and hands-on-work interest me.
I love projects like these.   I don't like things like that.

Male No Comments

Not interested (8)
Interesting (1)   Don't care (1)
I work (1)   Because it does not appeal to me, I'm more of a math guy.
No time (1)   It seems dumb.
Boring (2)   I'm scared of heights.

Amateur Radio	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	9	45%	3	8%	3	27%	3	9%
No	11	55%	32	89%	8	73%	29	88%
No Answer	0	0%	1	3%	0	0%	1	3%

Female Yes Comments

Boring (2) It's a neat opportunity. Seems cool to do.

Not Interested (3) I don't want to be on radio.

Don't have time I choose no because anything technical is too confusing for me.

Yes I would maybe consider it because it would be cool to be able to operate the radio tracking equipment.

It would be awesome to have to communicate with satellites.

Not really interested in the radio active field.

Female No Comments

Boring (3) Don't care (1) I don't know what any of that means.

Not interested (10) Don't want to (1) It's not my type of thing. Don't know (3)

Male Yes Comments

No time (2) I would never use it. It seems fun.

(No) It seems it would be hard to work with this kind of topic

(Yes) It could help with the earth (Yes) I would love to be on amateur radio.

(Yes) Receiving my radio license sounds interesting

Male No Comments

Sounds interesting Don't care (2) Laaaame It does not appeal to me.

Don't like talking Not interested (3) No time I don't like space.

Doesn't interest me because it has nothing to do for what I'm gonna do in the future

I don't like radios

WinGS	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	11	55%	3	8%	2	18%	3	9%
No	9	45%	32	89%	8	73%	30	91%
No Answer	0	0%	1	3%	1	9%	0	0%
Female Yes Comments								
Interesting (1)	It would be neat to communicate with low earth orbiting satellites.							
No time (1)	To see actual satellites are interesting.					Sounds fun.		
Boring (2)	Be really interesting and cool.				(Yes) that is pretty cool			
Female No Comments								
Boring (2)	Don't feel like it (1)			Don't like it (1)				
Not interested (7)	I don't really understand it					Don't care (2)		
Don't want to (1)	Learning about space seems boring to me.							
I wouldn't have a radio license anyway.				Not interested (4)				
Male Yes Comments								
No time (2)	(Yes) Receiving signals from other areas of the world interests me							
Male No Comments								
Not interested (4)	Don't like things like that.				Don't Care (1)			
Boring (2)	I would not want to work with this component because I don't like it.							
No time (3)	Does not appeal (1)				Don't like space (1)			

MSAC	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	12	60%	2	6%	6	55%	3	9%
No	8	40%	33	92%	4	36%	30	91%
No Answer	0	0%	1	3%	1	9%	0	0%

Female Yes Comments	
Not interested (1)	It would be cool to launch rockets, and balloons in the air.
Boring (1)	I would have to try that out and see what I learn.
No time (1)	This is something I'd like to do (I work in the summer).
(Yes) Now that seems interesting. I would like to experience launching a rocket.	
(Yes) It sounds like a lot of fun.	
Work (1)	Cool; space stuff just has always fascinated me.

Female No Comments		
Boring (1)	I don't want to spend my summer learning about space.	
Not into space (1)	(No) I don't like lectures	Not important to me.
Don't really want to spend my summer there.		
(No) I have my summer planned.	I have better things to do in July.	
Science I like, but not this.		
(No) Because I have plans in the summer with my family.		
I don't think science/space camps are fun for me.		

Male Yes Comments	
No time (2)	(Yes) I like dealing with and using rockets.
(Yes) I love space.	(Yes) Might be fun.
(Yes) Man this is so cool, of course I would like to do this. Yeah.	

Male No Comments			
Not interested (4)	Does not appeal (1)	Boring (1)	(No) I'm busy on July
Don't care (1)	(No) Waste of summer	Not time (3)	Don't like space (1)

37. Based on the above descriptions of WinCube, do you find the overall project appealing?

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
Yes	20	100%	0	0%	11	100%	0	0%
No	0	0%	35	97%	0	0%	33	100%
No Answer	0	0%	1	3%	0	0%	0	0%

Female Yes Comments
Most of them are boring. Because its something I'm interested in.
Some of it interests me, some of it doesn't.
Some interests me and some don't.
It's something really neat, not a lot of people would get to do.
Yes, I do but I'm not really interested. It sounds great for others though.
I choose yes because if I was really smart and really into science I would be all for this.
It's interesting, exciting and a really great experience that's filled with opportunities.
Yes because it would be cool for nerds, but not for me.
It feels like it has a lot to offer and I can learn a lot from it.
It sounds like certain people could like doing it but not me.

Female No Comments
Don't know (2) I am not interested in most of the aspects. Boring (2)
Not interested (10) I don't care about space! It's not interesting to me.
Not for me. I know other people who would be like this. Some parts seem boring.
Maybe, just not me. Space is boring to me. Not my place of interest.
Because space and such doesn't interest me enough to enroll in those activities.
I'm not quite impressed!

Male Yes Comments
(Yes) This could be a useful experience for me and because it is all about science,
I know I would enjoy it. It's just cool. Components are interesting.
It's amazing. Interesting topics.
It's a great proposal for students dedicated to science. It is very interesting.

Male No Comments
Not my thing Not interested in space. (No) Too much time.
Not interested (10) Don't care (1) Boring (1)
Somewhat, science its about space. Doesn't relate to me.
Pointless (1) Sounds a lot of work. Don't like space.

38. What activities in the WinCube Project sound interesting? (check all that apply)

	Female Yes		Female No		Male Yes		Male No	
	n	%	n	%	n	%	n	%
CubeSat	6	30%	4	11%	8	73%	5	15%
BCube	10	50%	3	8%	7	64%	2	6%
Amateur Radio	6	30%	5	14%	6	55%	5	15%
MSAC	13	65%	9	25%	7	64%	2	6%
WinGS	11	55%	2	6%	7	64%	3	9%
IADC	8	40%	3	8%	5	45%	2	6%
Industry tours	7	35%	3	8%	7	64%	3	9%
Universities	11	55%	12	33%	7	64%	7	21%
No answer	1	5%	13	36%	1	9%	19	58%
Number of Choices Per Student								
1	Female Yes		Female No		Male Yes		Male No	
2	n	%	n	%	n	%	n	%
3	2	10%	11	31%	2	18%	6	18%
4	4	20%	8	22%	0	0%	3	9%
5	3	15%	2	6%	1	9%	3	9%
6	5	25%	2	6%	1	9%	2	6%
7	0	0%	0	0%	0	0%	0	0%
8	0	0%	0	0%	1	9%	0	0%
	1	5%	0	0%	1	9%	0	0%
	3	15%	0	0%	4	36%	0	0%