

Public and Catholic District School Board Writing Partnerships

Course Profile Computer Engineering

Grade 11
Workplace Preparation
ICE3E

• *for teachers by teachers*

This sample course of study was prepared for teachers to use in meeting local classroom needs, as appropriate. This is not a mandated approach to the teaching of the course. It may be used in its entirety, in part, or adapted.

Course Profiles are professional development materials designed to help teachers implement the new Grade 11 secondary school curriculum. These materials were created by writing partnerships of school boards and subject associations. The development of these resources was funded by the Ontario Ministry of Education. This document reflects the views of the developers and not necessarily those of the Ministry. Permission is given to reproduce these materials for any purpose except profit. Teachers are also encouraged to amend, revise, edit, cut, paste, and otherwise adapt this material for educational purposes.

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Acknowledgments

Public and Catholic District School Board Writing Teams – Grade 11 Computer Engineering (ICE)

This profile is the result of a collaborative effort between the Institute for Catholic Education and the Halton District School Board.

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Course Overview

Computer Engineering, Grade 11, Workplace Preparation, ICE3E

Course Description

This course helps students develop a practical understanding of hardware and software operations, computer networks, and operating systems. Students learn to use utility and application software and to install, maintain, and troubleshoot computer systems and networks following proper maintenance and repair procedures. In addition to developing an understanding of the ethical use of computers, students identify related career opportunities and the skill sets required for the workplace, including good customer service practices.

How This Course Supports the Ontario Catholic School Graduate Expectations

The purpose of Computer Engineering programs in the Catholic faith community is to enable young adults to develop and utilize their gifts and resources to find solutions, develop ideas, and gain knowledge of concepts that benefit others in a way that models gospel values. A supportive computer classroom provides a caring and sensitive environment where the dignity and value of all students is respected and affirmed, as they grow in confidence in their computer engineering abilities. The computer curriculum focus enables students to be critical thinkers and innovative problem-solvers that question the use of human and physical resources, as well as individuals who understand the implications of computers and related innovations. Emphasis on problem solving models helps students create solutions that recognize our God-given responsibility to respect the dignity and value of the individual, protect the environment, and use the world's resources ethically and morally. Ethical issues to be discussed in this course may include:

- Intellectual property rights and illegal copying of software;
- Reverse engineering;
- Creation and distribution of viruses;
- Plagiarism;
- Sexual harassment/discrimination in the workplace;
- Computers and privacy;
- Protecting children on the Internet;
- Responsible research;
- Work and family;
- Impact of information technology on the developing world;
- Working conditions in information technology companies;
- Environmental impact of technology industries.

Course Notes

This course prepares students for further study in computer engineering and for employment. The combination of theory, practical experience, and exploration of career options also helps students complete and refine their Annual Education Plan.

This course is a prerequisite for Grade 12 Computer Engineering, Workplace Preparation, ICE4E, that may lead to direct employment in entry-level customer service jobs or post secondary programs which require an overview of computer hardware, system configuration, networking, troubleshooting, and customer service. This course provides skills and knowledge for computer-related careers such as sales person, technician, and technologist.

Some students may have completed Grade 10 Computer and Information Science or Computer Engineering and been introduced to basic programming concepts and structures. For others, this is their first Computer Engineering course. Since this course does not have a prerequisite, it will attract students that have a wide range of knowledge.

Students are given paper or, preferably, electronic copies of assignments and labs, identifying expectations being assessed/evaluated for each activity. Students work in a hands-on environment and must have clear goals to successfully achieve expectations. Teachers provide feedback for improvement through individual and group conferencing.

Daily logs and journals are useful tools for practising writing skills, documenting activities, and increasing vocabulary of computer terminology. Students add the following to their personal database: glossary of terms, hardware/software knowledge and career information. They also create a personal portfolio of exemplary and completed customer service work, as well as new skills and knowledge gained throughout the course. Students concentrate on practising task documentation and time-management skills and following instructions in individual and group settings.

It is advantageous for students to have access to a network of computers that are not networked into the main school system. Students also require computers that are part of the main system for research and software applications. In-class facilities with stand-alone computers that allow students to disassemble, assemble, and troubleshoot computer hardware systems and computer networks are recommended. The community is an ideal source of computer equipment to serve these functions (e.g., Computers For Schools).

Customer service and troubleshooting activities of Units 4 and 5 are two recurring themes that provide continuity for the theoretical and practical activities in Units 1, 2, and 3. Initially, troubleshooting can be developed on equipment with teacher-induced faults, and teachers acting as customers. Refurbishing and upgrading computers provides a wealth of customer service and technical skill development. As students' knowledge and skills develop, customer computers are used to provide workplace experiences. Students also design their own diagnostics forms to record problems and solutions. This instills a sense of ownership for the students.

Most units involve hands-on work with computers and peripheral devices. A focus on safe and proper handling practices is required and reviewed on a continuous basis. Secure storage is provided for work in progress. Safety tests and signed safety agreements are recommended.

Teachers should review school district policies regarding appropriate student use and access to Internet services. Refer to the Grade 10 Computer and Information Science Course Profile for activities to assist students in using the Internet as a resource tool and the Grade 10 Computer Engineering Course Profile for computer technology foundation and for review of activities.

Units: Titles and Time

* Unit 1	Hardware/Components/Peripherals	23 hours
Unit 2	System Configuration	30 hours
* Unit 3	Networking	15 hours
Unit 4	Customer Service	17 hours
Unit 5	Practical Computers – Troubleshooting	25 hours

* These units are fully developed in this Course Profile.

Unit 1: Hardware/Components/Peripherals

Time: 23 hours

Unit Description

This unit focuses on internal and external hardware components. Students disassemble, assemble, and upgrade computer components, and install drivers to configure computer hardware systems and recommend computer components and peripherals based on customer needs. Safety is emphasized when handling internal and external components.

A database of hardware components, logs of system changes and upgrades, and a glossary are created by students to help them understand terms and illustrate hardware management techniques. Students identify employability skills and explore careers in the computer hardware industry.

Unit Overview Chart

Cluster	Expectations	Assessment/Evaluation	Focus
1	TFV.01, TFV.03, TF1.01, TF1.02, TF1.11, SPV.01, SP1.04, SP1.05, SP1.06, SP1.07, SP1.10, IC1.02 CGE 3b	Communication Knowledge/Understanding Application Thinking/Inquiry	Computer hardware, firmware, components
2	TFV.01, TFV.03, TF1.02, TF1.11, SP1.03, SP1.13 CGE 3c, 5e	Communication Knowledge/Understanding Application Thinking/Inquiry	Computer assembly and testing
3	TF1.04, TF1.05, TF1.06, TF1.11, SP1.02, SP1.08, SP1.09, SP1.11, SP1.14, SP2.04, SP2.05, SP2.06, CGE 4f, 5e	Knowledge/Understanding Communication Application	Computer Upgrading

Unit 2: System Configuration

Time: 30 hours

Unit Description

This unit focuses on the functions of hardware components and software of a typical computer system, including the internal BIOS and operating systems. Students format, scan, partition, and enable both primary and secondary hard drives, and install an operating system and drivers to configure the computer hardware and peripherals they assembled in Unit 1. Students also recommend computer system configurations based on customer specific application software and input/output requirements. Students also review employability skills and further explore careers in the computer industry, including software. Software copyright and legal ownership are discussed in light of gospel values and an informed moral conscience.

Unit Overview Chart

Cluster	Expectations	Assessment/Evaluation	Focus
1	TF1.03, SPV.01, SP1.10, SP1.13	Knowledge/Understanding Communication Application	Motherboard activity
2	TF1.10	Communication Application	Computer Boot Sequence, CMOS installation

3	TFV.03, TF1.03, TF1.07, TF1.11, SPV.01 CGE4a	Knowledge/Understanding Communication Application	Hard Drive preparation and installation
4	TF1.04, TF2.02, SPV.03, SP2.05 CGE4a, 5e, 7b, 7h	Knowledge/Understanding Communication Application	Installation of operating system
5	SP1.03, SP1.11, SP1.14 CGE4a	Application	Configuring and back up
6	TF2.01, TF2.02, SPV.05, SP1.01, SP1.02, SP2.01, SP2.02 CGE4a, 7a	Communication Application	Developing a product to meet customer needs

Unit 3: Networking

Time: 15 hours

Unit Description

This unit focuses on basic network components, network cables, network types, and topologies. Students install network cards, activate computer operating systems for network access, install and configure computers for given network operating systems, and define computer network interfaces. They learn the importance of network connectivity and infrastructure (dial-up, LAN, WAN, and Internet) and how it impacts on our world, as well as potential career opportunities in the area of computer networking. Importance of proper documented communications is stressed when dealing with customer requests. Students practise attitudes and values founded on Catholic social teaching when dealing with clients.

Unit Overview Chart

Cluster	Expectations	Assessment/Evaluation	Focus
1	TFV.01, TFV.02, TF1.01, TF1.07, TF1.09, SP2.01, ICV.04 CGE 2b, 2e, 3b, 3c	Communication Application Knowledge/Understanding	Networks types, topologies and architectures
2	TFV.02, TFV.03, TF1.01, SPV.02, SP1.05, SP1.10, SP2.01, ICV.04 CGE 3b, 3c, 4f	Application	Network cards and cabling, tools and accessories
3	SPV.02, SP1.03, SP1.10, SP2.01, ICV.04 CGE3b, 4f	Application Thinking/Inquiry	Network protocol and utilities
4	TFV.01, TFV.02, TF1.01, SPV.03, SPV.05, SP1.01, SP1.02, SP1.03, SP1.12, SP1.15, SP2.01, SP2.05, SP2.06, ICV.02, ICV.04, IC1.02, IC1.04, IC1.05 CGE3b, 3c, 4c, 5e	Communication Thinking/Inquiry Application	Client server and peer/peer networks
5	TF2.02, SPV.01, SPV.02, SPV.05, SP1.04, SP1.06, SP1.07, SP2.01, SP2.04, SP2.05, ICV.02, ICV.03, ICV.04, IC1.03, IC1.04, IC1.05 CGE3b, 3f, 4f, 5a	Knowledge/Understanding Communication Thinking/Inquiry	Setup and troubleshooting a network. Network security

Unit 4: Customer Service

Time: 17 hours

Unit Description

This unit focuses on customer service and career education in the computer field. Students are provided realistic customer opportunities to service and work on family, school, and community computers emphasizing record keeping and costing. They also explore the possibilities of self-employment in the field of computer maintenance and repair. The Christian concepts of moral obligation and fair business practices are reinforced throughout the activities.

Unit Overview Chart

Cluster	Expectations	Assessment/Evaluation	Focus
1	TFV.04, TF2.01 CGE1d, 2a, 4a, 7a	Knowledge/Understanding Communication Thinking/Inquiry Application	Customer communications
2	SP1.15, SP2.03 CGE1d, 3d, 4a, 7a	Application Communication Thinking/Inquiry	Identifying customer needs
3	TF2.02, SP2.04 CGE1d, 4a, 7a	Communication Thinking/Inquiry Application	Managing customer information
4	IC1.02, IC1.01, IC1.04, 1CV.01, ICV.03, IC1.03 CGE1d, 4a, 5b, 5d 7a, 7g	Knowledge/Understanding Application Communication Thinking/Inquiry	Case studies
5	SPV.03, SP2.03, SP2.04, SP2.05, SP2.06, SP1.15, IC1.06 CGE1d, 2c, 2e, 4a, 4f, 5e, 5f, 7a	Knowledge/Understanding Application Thinking/Inquiry	Customer needs and solutions

Unit 5: Practical Computers – Troubleshooting

Time: 25 hours

Unit Description

This unit focuses on troubleshooting hardware, software, and network problems. Students develop an understanding of common computer hardware, software, and network problems and develop transferable problem-solving skills. Students listen actively and critically, and think reflectively and creatively, to make decisions in light of gospel values when communicating with customers.

Unit Overview Chart

Cluster	Expectations	Assessment/Evaluation	Focus
1	SPV.01, SP1.01, SP1.04, SP2.05 CGE1d, 3c, 4a, 7a	Knowledge/Understanding Communication Thinking/Inquiry Application	Analytical troubleshooting
2	TFV.01, TFV.03, SP2.04, SP2.06 CGE1d, 3c, 4a, 7a	Communication Knowledge/Understanding Thinking/Inquiry Application	Troubleshooting hardware

3	TF1.04, TF1.05, SP1.09, SP2.04, SP2.06 CGE1d, 3c, 4a, 7a	Knowledge Communication Application Thinking/Inquiry	Troubleshooting software
4	SP1.04, SP1.05, SP1.06, SP2.04, SP2.06 CGE1d, 3c, 4a, 7a	Application Thinking/Inquiry Application	Troubleshooting networks
5	TFV.04, TF2.02, SPV.05, SP2.01, SP2.02, SP2.03, SP2.04 CGE1d, 2c, 2d, 3c, 4a, 7a	Knowledge/Understanding Communication Application Thinking/Inquiry	Recommending a solution to the customer

Teaching/Learning Strategies

The selection of Teaching/Learning Strategies is directly related to the achievement categories:

Knowledge/Understanding

- Whole group instruction: teacher-and/or student-led instruction to introduce new concepts and skill development;
- Small group instruction: peer led, conferencing, discussion, debate, presentation, collaborative/cooperative;
- Individual: research, independent study.

Thinking/Inquiry

- Research;
- Presentation;
- Open-ended problem-solving;
- Authentic tasks.

Communication

- Presentations;
- Reports;
- Discussion;
- Debates.

Application

- Design projects;
- Lab reports;
- Oral presentations;
- Computer programs;
- Creation of products.

The Teaching/Learning Strategies most appropriate to computer engineering workplace are those addressing the greatest range of expectations and providing students with the opportunities to demonstrate their fullest range of learning. The Teaching/Learning Strategies most appropriate to this discipline and this destination include opportunities such as:

- Allowing students to work in a hands-on environment;
- Opportunities to solve open-ended and contextual problems, i.e., opportunities to deal with customers in realistic situations in order to develop the interpersonal skills required by future employers.

Assessment & Evaluation of Student Achievement

The selection of Assessment/Evaluation Techniques is also directly related to the achievement chart categories:

Knowledge/Understanding

- Paper-and-pencil – quiz, test (multiple-choice, fill-in-blanks), examinations;
- Performance – open-ended questions, organizers, tables, graphs, illustrations;
- Personal communication – in-class question and answer, open discussions, oral test or examinations.

Thinking/Inquiry

- Paper-and-pencil – open-ended questions, examinations, organizers;
- Performance – essays, articles, research papers, oral presentations, creation of products;
- Personal Communication – in-class question and answer, student-teacher conferencing, small- group/teacher conferencing.

Communication

- Paper-and-pencil – open-ended questions, tests, presentations, organizers, visuals;
- Performance – lab reports, presentation, creation of products;
- Personal communication – in-class question and answer, discussions, and conferencing.

Application

- Paper-and-pencil – open-ended questions allowing for knowledge to be applied to a new situation;
- Performance – lab reports, creations, models, oral presentations, computer programs;
- Personal Communication – interviews, student-teacher conferencing.

Students are provided with opportunities to demonstrate the highest level of their achievement of the expectations in the four achievement categories.

Students are assessed and evaluated using the following strategies:

Diagnostic: whenever information about prior learning is useful, such as at the beginning of a term or a unit of study. For example:

- unit pre-tests;
- skill inventory.

Formative: during the teaching-learning process, students should be provided with ongoing feedback on their strengths and weaknesses and their meeting course expectations. For example:

- communication through journals;
- self assessment rubrics;
- checklists;
- student/teacher conferencing;
- observation;
- peer assessment rubrics;
- quizzes;
- anecdotal comments with suggestions for improvement.

Summative: at the end of a learning process. For example:

- classroom presentations;
- written and practical quizzes, tests, unit tests, final exam;
- assignments and projects evaluated using rubrics;
- culminating challenges.

Accommodations

The following are strategies used in the units:

- referencing and inclusion of recommendations from student OSRs, and IEPs for exceptional students;
- providing adaptive hardware devices (e.g., large screen monitors, larger fonts, specially designed keyboards);
- providing appropriate environmental accommodations for students with physical disabilities;
- conferencing with Special Education staff and students to discuss accommodation and to make certain that the physical aspects of the environment meet the needs of the students and the program;
- providing word lists, glossaries, definition of terms, and visuals, if available;
- grouping weaker students with stronger students to assist in instructional remediation and provide a further challenge as students become teachers;
- allowing more time to organize and complete assignments;
- providing a choice of assignment formats where possible;
- selecting problems that involve programming topics familiar to students so they have a better understanding of the requirements (e.g., a student who plays basketball writes a program that keeps basketball statistics);
- providing additional materials to reinforce or extend learning;
- providing opportunities for those students requiring enhancement of program;
- using visual and audio-visual aids;
- adjusting expectations for written work and the number of assignments required;
- providing for alternative displays of achievement such as oral testing, taped answers, and scribing for students with writing difficulties;
- providing clarification to students of assessment/evaluation tools such as rubrics and checklists.

Environmental Concerns

- checking with administration, academic resource personnel, and guidance counsellors to make certain that all aids, environmental issues, safety precautions, and assistance for students to experience success in the program are in place;
- dialoguing/conferencing with students to discuss accommodations to make certain that the surroundings meet the needs of the students.

Assessment Accommodations

- providing additional review for students having difficulty integrating all the structures;
- allowing for non-timed evaluations for identified students;
- ensuring students understand assessment/evaluation tools;
- providing the option for oral testing and student demonstrations of acquired skills.

Enrichment

- organizing more advanced problems (e.g., design work, research paper, alternate interfacing projects) for identified enrichment students;
- appointing students as assistant site administrators.

Physical Accommodations

- providing appropriate adaptive devices (e.g., large screen monitors, touch screens, etc.) or implementation accommodations for identified students;
- providing support for students with special needs during hands-on sessions.

Instructional Accommodations

- providing peer tutoring;
- providing flexible timelines;
- encouraging small group learning;
- encouraging student-to-student discussion and teacher-to-student discussion to encourage confidence and motivation;
- providing written materials for students having difficulty processing auditory information;
- providing handouts to reinforce demonstrations;
- providing supplementary print and/or audiovisual aids to support activities.
- accommodating learning styles.

Resources

Note Concerning Permissions

Units in this profile make reference to the use of specific texts, magazines, films, and videos. Before reproducing materials for student use from books and magazines, teachers need to ensure that their board has a Cancopy licence and that resources they wish to use are covered by this licence. Before screening videos for their students, teachers need to ensure that their board/school has obtained the appropriate public performance videocassette licence from an authorized distributor (e.g., Audio Cine Films Inc.). Teachers are also reminded that much of the material on the Internet is protected by copyright. That copyright is usually owned by the person or organization that created the work. Reproduction of any work or a substantial part of any work on the Internet is not allowed without the permission of the owner.

Human Resources

Community libraries, and school Library/Resource Centre.
Community partners and computer industry personnel.
School board technical service personnel.

Print

Operating system manuals and reference texts

Feldman, Jonathon. *Sams Teach Yourself Network Troubleshooting in 24 Hours*. Sams, 1998. ISBN 0672314886

Glover, Thomas J. and Millie M. Young. *Pocket Pcref*, 10th ed., Sequoia Publishing, 2000. ISBN 1-885071-27-2

Gregg, Kenneth. *Windows Networking Basics*. Harper Collins Canada, 1998. ISBN 0764532146

Kearns, Dave. *Sams Teach Yourself Windows Networking in 24 Hours*. Sams, 1998. ISBN 0672314754

Keogh, Jim. *Core MCSE: Networking Essentials*. Prentice-Hall of Canada Ltd., ISBN 0130107336

Magendanz, Thomas and Radu Popescu-Zeletin. *Intelligent Networks: Basic Technology, Standards & Evolution*. International Thomson Press, 1996. ISBN 1850322937

MCSE Networking Essentials For Dummies, Training Kit. IDG Books Worldwide, 1999. ISBN 0764506218

Meuller, Scott. *Updating and Repairing PCs*, 12th ed. Que Publishing 2000. ISBN: 0-789-71903-7

Minasi, Mark. *The Complete PC Upgrade and Maintenance Seminar In A Box*. SYBEX, 2000. ISBN 07821-2706-1

Network A+ Certification Study Guide. Syngress Media, Inc., 1999. ISBN 0-07-211846-6

Norton, Peter. *Complete Guide to PC Upgrades*, 2nd ed. SAMS, 1999. ISBN 0-672-31483-5

Norton, Peter. *Essential Concepts*. McGraw-Hill Ryerson Limited, 1999. ISBN 0-02-804394-4

Parsons, Oja. *Computer Concepts*. 1996. ISBN 0-7600-3440-0

Shelly, Gary and Thomas Cashman. *Computer Fundamentals for an Information Age*. California: Anaheim Publishing Co., 1984. ISBN 0-88236-125-2

Smyth, Graham and Christine Stephenson. *Computer Engineering: An Activities-Based Approach*. Toronto: Holt Software, 2000. ISBN 0-921598-36-X

Tokheim, Roger. *Digital Electronics*, 4th ed. McGraw Hill Book Company, 1994. ISBN 002-801853-2

White, Ron. *How Computers Work*, 3rd ed. (with Interactive CD). Que. Publishing: 1998. ISBN 0-7897-1650-X

White, Ron. *How Computers Work*, Deluxe Edition. Ziff Davis Press, New York, New York: 1998. ISBN 1-56276-5469

Software

OESS software tools (e.g., *Corel WordPerfect*, *Microsoft Works*, *Appleworks*, *Microsoft Word*, etc.)

Operating systems (e.g., DOS, Windows 9X, Windows ME, Windows 2000, UNIX, Linux or others)

Web and FTP server and client applications

Video

The Journey Inside. Intel Corporation. Part of *The Journey Inside* Education kit
<http://secure.wesweb.com/intel/form.htm>
Contains two videos, an instructional binder, and electronic components

Websites

Note: The URLs for the websites have been verified by the writer prior to publication. Given the frequency with which these designations change, teachers should always verify the websites prior to assigning them for student use.

How Things Work – <http://howthingswork.com>

Novell Network Primer – <http://www.novell.com/catalog/primer/primer.html>

IT Careers – <http://www.itcareers.com>

Intel Resources – <http://www.intel.com/education/k12/resources/index.htm>

Cisco Certification CCIE – <http://www.cisco.com/warp/public/625/ccie/>

Microsoft Educational Resources – <http://www.microsoft.com/education/instruction/default.asp>

3Com's Netprep programme – <http://education.3com.com/Netprep/index.html>

Computer assembly sites – <http://oakroadsystems.com/tech/hd-partn.htm>
<http://www.pcmec.com/build.htm>

Operation of computer and components – <http://www.karbosguide.com/index2.htm>

How to make network cables, network two WIN9X computers, more
<http://www.duxcw.com/digest/Howto/index.html>
<http://www.startech.com/structuredwiring/patchcable.htm>

Hard Drive Testing – <http://www.tcdlabs.com/hdtach.htm>

Guide for troubleshooting and repairing clones – <http://www.daileyint.com/hmdpc/manual.htm>

Online Ethics Centre for Science and Engineering – <http://www.onlineethics.org>

Computer Professionals for Social Responsibility – <http://www.cpsr.org/>

Privacy International – <http://www.privacyinternational.org/>

Electronic Privacy Information Centre – <http://www.epic.org/>

Business Ethics Magazine – <http://www.business-ethics.com/>

OSS Considerations

The Grade 11 Computer Engineering is a Computer Studies course within Technological Studies. The Computer Studies courses offered at the Grade 11 level are University/College or Workplace. (See *The Ontario Curriculum, Grades 9 to 12, Program Planning and Assessment, 2000* for a description of the different types of secondary school courses). This course is designed to provide students with a solid background in customer service and relationships between software and hardware and prepare them for Computer Engineering studies in Grade 12, entry into the workplace, or post-secondary education. Anti-discrimination education, equity issues, career goals/cooperative education, and community partnerships are also discussed in this course. All of these support many of the Ontario Secondary School Policies. Career exploration throughout all units is available to students with specific reference to *Choices into Action: Guidance and Career Education Program Policy for Elementary and Secondary Schools, 1999*. With the implementation of apprenticeship opportunities in the Information Technology sector, students should be encouraged to pursue cooperative education opportunities and may start to explore OYAP opportunities in this sector.

Coded Expectations, Computer Engineering, Grade 11, Workplace Preparation, ICE3E

Theory and Foundation

Overall Expectations

- TFV.01 · describe current hardware and software products;
- TFV.02 · describe computer networks and operating systems;
- TFV.03 · identify required procedures for the safe handling of electronic components;
- TFV.04 · define what constitutes good customer service practices.

Specific Expectations

Hardware, Interfaces, and Networking Systems

- TF1.01 – identify current hardware products and their uses;
- TF1.02 – explain the function of computer peripherals (e.g., mouse, keyboard, screen, printer, multimedia devices);
- TF1.03 – explain technical information in current computer advertisements;
- TF1.04 – identify current software products, their uses, and their hardware requirements;
- TF1.05 – specify criteria for the selection of software;
- TF1.06 – explain the hierarchical structure used to organize directories and files;
- TF1.07 – describe the advantages and disadvantages of networked versus stand-alone computing;
- TF1.08 – describe the concept of a global computer network;
- TF1.09 – explain the similarities and differences between local and wide area networks;
- TF1.10 – describe the requirements of different operating systems;
- TF1.11 – explain the correct procedures for handling components that use electrical power.

Customer Service

- TF2.01 – describe the importance of telephone etiquette and appropriate personal appearance and demeanour;
- TF2.02 – explain the importance of keeping records of customer contacts, including the following: customer name, contact information, date, time, description of technical problem, and proposed solution.

Skills and Processes

Overall Expectations

- SPV.01 · follow maintenance and repair procedures;
- SPV.02 · use utility and application software effectively;
- SPV.03 · determine user computing requirements;
- SPV.04 · use network services effectively;
- SPV.05 · demonstrate professional customer service practices.

Specific Expectations

Hardware, Interfaces, and Networking Systems

- SP1.01 – recommend appropriate hardware and software based on user needs;
- SP1.02 – cost out computer systems accurately, including all components and peripherals;
- SP1.03 – properly set up and configure computer systems;
- SP1.04 – follow prescribed troubleshooting procedures effectively;

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- SP1.05** – properly install and configure expansion components (e.g., video/network/modem cards, memory, secondary storage devices);
 - SP1.06** – perform basic maintenance on peripherals;
 - SP1.07** – use utility software to diagnose and correct problems;
 - SP1.08** – install and update virus-checking software;
 - SP1.09** – properly install and configure software upgrades;
 - SP1.10** – use appropriately prescribed methods of handling computer hardware;
 - SP1.11** – perform backup procedures effectively;
 - SP1.12** – use network resources to gather product information;
 - SP1.13** – maintain a glossary of computer terms and acronyms;
 - SP1.14** – prepare storage media for use;
 - SP1.15** – design effective home computer set-ups, including technical and ergonomic considerations.

Customer Service

- SP2.01** – use computer terminology correctly;
- SP2.02** – demonstrate an ability to communicate effectively with clients;
- SP2.03** – demonstrate an ability to deal with customers in an organized and professional manner;
- SP2.04** – maintain service logs effectively using a database and/or word processor;
- SP2.05** – develop installation and service procedures;
- SP2.06** – demonstrate an ability to follow peer-developed installation or service procedures.

Impact and Consequences

Overall Expectations

- ICV.01** · describe examples of ethical and non-ethical uses of computers;
- ICV.02** · identify skill sets required for the workplace;
- ICV.03** · describe workplace opportunities;
- ICV.04** · communicate and work effectively individually and in groups.

Specific Expectations

- IC1.01** – comply with ethical and acceptable policies for computer use;
- IC1.02** – identify social and computer skills that are important to employers;
- IC1.03** – describe job opportunities in local business and industry;
- IC1.04** – employ time management skills effectively in the completion of projects;
- IC1.05** – effectively communicate the results of projects both orally and in writing;
- IC1.06** – use appropriate strategies to avoid potential health and safety problems associated with computer use, such as musculo-skeletal disorders and eye strain.

Ontario Catholic School Graduate Expectations

The graduate is expected to be:

A Discerning Believer Formed in the Catholic Faith Community who

- CGE1a** -illustrates a basic understanding of the **saving story** of our Christian faith;
- CGE1b** -participates in the **sacramental life** of the church and demonstrates an understanding of the centrality of the Eucharist to our Catholic story;
- CGE1c** -actively reflects on **God’s Word** as communicated through the Hebrew and Christian scriptures;
- CGE1d** -develops attitudes and values founded on Catholic **social teaching** and acts to promote social responsibility, human solidarity and the common good;
- CGE1e** -speaks the **language of life**... “recognizing that life is an unearned gift and that a person entrusted with life does not own it but that one is called to protect and cherish it.” (Witnesses to Faith)
- CGE1f** -seeks intimacy with God and celebrates **communion** with God, others and creation through prayer and worship;
- CGE1g** -understands that one’s purpose or **call in life** comes from God and strives to discern and live out this call throughout life’s journey;
- CGE1h** -respects the **faith traditions**, world religions and the life-journeys of **all people of good will**;
- CGE1i** -integrates faith with life;
- CGE1j** -recognizes that “sin, human weakness, conflict and forgiveness are part of the human journey” and that the cross, the ultimate sign of forgiveness is at the heart of **redemption**. (Witnesses to Faith)

An Effective Communicator who

- CGE2a** -listens actively and critically to understand and learn in light of gospel values;
- CGE2b** -reads, understands and uses written materials effectively;
- CGE2c** -presents information and ideas clearly and honestly and with sensitivity to others;
- CGE2d** -writes and speaks fluently one or both of Canada’s official languages;
- CGE2e** -uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology and information systems to enhance the quality of life.

A Reflective and Creative Thinker who

- CGE3a** -recognizes there is more grace in our world than sin and that hope is essential in facing all challenges;
- CGE3b** -creates, adapts, evaluates new ideas in light of the common good;
- CGE3c** -thinks reflectively and creatively to evaluate situations and solve problems;
- CGE3d** -makes decisions in light of gospel values with an informed moral conscience;
- CGE3e** -adopts a holistic approach to life by integrating learning from various subject areas and experience;
- CGE3f** -examines, evaluates and applies knowledge of interdependent systems (physical, political, ethical, socio-economic and ecological) for the development of a just and compassionate society.

A Self-Directed, Responsible, Life Long Learner who

- CGE4a** -demonstrates a confident and positive sense of self and respect for the dignity and welfare of others;
- CGE4b** -demonstrates flexibility and adaptability;
- CGE4c** -takes initiative and demonstrates Christian leadership;
- CGE4d** -responds to, manages and constructively influences change in a discerning manner;
- CGE4e** -sets appropriate goals and priorities in school, work and personal life;
- CGE4f** -applies effective communication, decision-making, problem-solving, time and resource management skills;
- CGE4g** -examines and reflects on one's personal values, abilities and aspirations influencing life's choices and opportunities;
- CGE4h** -participates in leisure and fitness activities for a balanced and healthy lifestyle.

A Collaborative Contributor who

- CGE5a** -works effectively as an interdependent team member;
- CGE5b** -thinks critically about the meaning and purpose of work;
- CGE5c** -develops one's God-given potential and makes a meaningful contribution to society;
- CGE5d** -finds meaning, dignity, fulfillment and vocation in work which contributes to the common good;
- CGE5e** -respects the rights, responsibilities and contributions of self and others;
- CGE5f** -exercises Christian leadership in the achievement of individual and group goals;
- CGE5g** -achieves excellence, originality, and integrity in one's own work and supports these qualities in the work of others;
- CGE5h** -applies skills for employability, self-employment and entrepreneurship relative to Christian vocation.

A Caring Family Member who

- CGE6a** -relates to family members in a loving, compassionate and respectful manner;
- CGE6b** -recognizes human intimacy and sexuality as God given gifts, to be used as the creator intended;
- CGE6c** -values and honours the important role of the family in society;
- CGE6d** -values and nurtures opportunities for family prayer;
- CGE6e** -ministers to the family, school, parish, and wider community through service.

A Responsible Citizen who

- CGE7a** -acts morally and legally as a person formed in Catholic traditions;
- CGE7b** -accepts accountability for one's own actions;
- CGE7c** -seeks and grants forgiveness;
- CGE7d** -promotes the sacredness of life;
- CGE7e** -witnesses Catholic social teaching by promoting equality, democracy, and solidarity for a just, peaceful and compassionate society;
- CGE7f** -respects and affirms the diversity and interdependence of the world's peoples and cultures;
- CGE7g** -respects and understands the history, cultural heritage and pluralism of today's contemporary society;
- CGE7h** -exercises the rights and responsibilities of Canadian citizenship;
- CGE7i** -respects the environment and uses resources wisely;
- CGE7j** -contributes to the common good.

Unit 1: Hardware/Components/Peripherals

Time: 23 hours

Description

This unit focuses on internal and external hardware components. Students disassemble, assemble, and upgrade computer components, install drivers to configure computer hardware systems, and recommend computer components and peripherals based on customer needs. Safety is emphasized when students handle internal and external components.

A database of hardware components, logs of system changes and upgrades, and a glossary are created by students to help them understand terms and illustrate hardware management techniques. They identify employability skills and explore careers in the computer hardware industry.

Unit Synopsis Chart

Activity	Time	Expectations	Evaluation	Tasks (Strategy)
1. Computer hardware, firmware, components	660 min	TFV.01, TFV.03, TF1.01, TF1.02, TF1.11, SPV.01, SP1.04, SP1.05, SP1.06, SP1.07, SP1.10, ICV.02	Communication Knowledge/ Understanding Application Thinking/Inquiry	Identifying motherboard (Mbd) on-board components. Identify peripherals and their interconnections. Disassemble system, with emphasis on tool use, component/device ID, connections, documentation, research of functionality. Focus on safe practices.
2. Computer assembly and testing	480 min	TFV.01, TFV.03, TF1.02, TF1.11, SP1.03, SP1.13	Communication Knowledge/ Understanding Application Thinking/Inquiry	Reassemble working computer. Emphasize sequence of process. Prepare the hard drive for an operating system and enhancements. Verify against check list that system works correctly in stages.
3. Computer Upgrading	240 min	TF1.04, TF1.05, TF1.06, TF1.11, SP1.02, SP1.08, SP1.09, SP1.11, SP1.14, SP2.04, SP2.05, SP2.06	Knowledge/ Understanding Communication Application	Upgrading a computer system. Installing and configuring software and hardware. (1) software (a) BIOS setup, (b) BIOS upgrade, (c) Op Sys upgrade and (2) hardware (a) overdrive CPU (b) upgrade RAM

Activity 1: Computer Hardware, Firmware, Components

Time: 660 minutes

Description

Students are introduced to computer hardware and peripherals that make up a typical computer system. The emphasis is on practice rather than theory. This is accomplished through the actual assembly and disassembly of a computer system. Students start a logbook (Appendix 1.1.1) to track their accomplishments, and compile a glossary of terms to assist with the development of appropriate language (Appendix 1.1.2). Safety procedures are reviewed on a regular basis to ensure that students use appropriate methods and work safely.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes, Impact and Consequences

Overall Expectations

TFV.01 - describe current hardware and software products;

TFV.03 - identify required procedures for the safe handling of electronic components;

SPV.01 - follows maintenance and repair procedures;

ICV.02 - identify skill sets required for the workplace.

Specific Expectations

TF1.01 - identify current hardware product and their uses;

TF1.02 - explain the function of computer peripherals (e.g., mouse, keyboard, screen, printer, multimedia devices);

TF1.11 - explain the correct procedure for handling components that use electrical power;

SP1.04 - follow prescribed troubleshooting procedures effectively;

SP1.05 - properly install and configure expansion components (e.g., video/network/modem cards, memory, secondary storage devices);

SP1.06 - perform basic maintenance on peripherals;

SP1.07 - use utility software to diagnose and correct problems;

SP1.10 - use appropriately prescribed methods of handling computer hardware;

SP1.13 - maintain a glossary.

Prior Knowledge & Skills

- Hardware and peripheral familiarization about computers
- Personal computer skills learned from general use of a computer

Planning Notes

- Have copies of the Board's Internet Acceptable Use Policy, if it exists.
- Review safety with electricity and the proper handling of computer components.
- Prepare a Computer Safety Worksheet (see Appendix 1.1.4 for a sample) for electrical connection, tool use, and parts handling.
- Prepare a demonstration centre with the various components of a computer system: motherboard with RAM, ROM and battery; CPU; power supply; video card; I/O card; sound card; internal modem; ribbons, cables and connectors.
- Ensure parts/components storage area is well-organized and assist in the management and distribution of parts/components.
- Ensure students remove acrylic or wool sweaters before handling components of computers.
- Ensure students discharge themselves before handling components or computers.

-
- Prepare a damaged hard drive, a power supply, and a floppy disk for demonstration purposes (open the hard drive of floppy drive so students are able to see the actual media).
 - Prepare lessons on the following: the motherboard (CPU, chip set, expansion slots, I/O connections), Memory (RAM, ROM, Cache), Input/Output Devices, Storage Devices (fixed disk, floppy disk, CD-ROM, DVD).
 - Prepare any type of visual representation, i.e., Overhead, Computer graphic, of a typical computer. Where hardware is not available, consult Resources to create appropriate overheads, multimedia presentations, or handouts.

Teaching/Learning Strategies

1. Review safety considerations when working with computer internals and with electronic components.
2. Hand out and discuss copies of the Board's Internet Acceptable Use Policy, if it exists.
3. Students maintain a portfolio in binders (worksheets, safe use policy, etc.) as well as electronic medium (logs, glossary, research, comparisons, etc.)
4. Identify and discuss proper use of the tools.
5. Students design and produce a computer disassembly log sheet form, used throughout this unit. This form may be personalized as long as it follows certain criteria. See Appendix 1.1.3 for a sample. Students work in groups and are encouraged to "set up" a company. A proper logo and company name should be chosen and included on this form.
6. Give students a handout of a visual representation of a computer system. Students start a glossary of terms pertaining to the system. See Appendix 1.1.1 for terminology.
7. Show students the components and discuss each one. Let students handle the components and discuss the safe handling in light of possible damage to the electronic circuitry, (e.g., when bending IC pins) as well as possible injury from sharp edges or points.
8. Show students how each component communicates with the motherboard through ribbons, cables and connectors. Have students identify pin 1 on such devices as hard drives and floppy drives and identify the corresponding ribbon with the coloured wire.
9. Show students the difference between a PCI and an ISA/EISA slot. If a more up-to-date motherboard is available, show the USB port and other advanced connections.
10. Show students the interior of a hard drive, floppy disk, and mouse. With the hard drive exposed, connect the hard drive to a power supply. After turning on the power supply, students see the read/write head initiating and they will notice the speed at which the hard drive turns. At this time a discussion of RPM can be held.
11. Show students an exposed 3.5" floppy disk and discuss the mechanics of this device.
12. Students turn on the computers, observe and log the boot-up sequence. This is done to recognize the main steps to the boot sequence and to show students the system boots up properly before disassembly.
13. After turning off the systems, students remove the cases and begin disassembling the computers. While they disassemble the computers, students make notes on where devices are connected. They label devices and connectors, and complete the Computer Disassembly Log sheet (Appendix 1.1.3).
14. A situation may be established in which one student or one group of students assembles a computer and purposely omits one of the components or does a faulty hook-up (or both). This student or group of students, presents this computer to another student or group of students, who are then responsible for troubleshooting the system. A discussion on work ethics and customer service should be held at this point. Assessment may be based on peer evaluation.
15. Students must keep their glossary of terms updated, and at the end of this activity they submit this for evaluation.

Assessment & Evaluation of Student Achievement

- Ongoing evaluation by observation allows the teacher to see if students are using the tools safely and are able to disassemble and re-assemble a computer. Students are evaluated on their work ethics and time spent in trouble-shooting by completing a log sheet that clearly identifies the task and the time spent on task (Appendix 1.1.2).
- End this activity with a test on the assembly and reassembly of the computer (Appendix 1.1.5).
- To reinforce the importance of safety when working with electronic components, tools and electricity students complete the computer safety quiz provided (Appendix 1.1.4).
- The use of appropriate terminology and ability to identify and describe internal and external components and peripherals is assessed using the rubric (Appendix 1.1.6). This rubric is also used to assess safe work habits.

Accommodations

- Pre-teach vocabulary and definitions prior to and during lesson when necessary.
- Provide a partially completed glossary that students complete on their own or with assistance from their peers.
- Monitor individual progress in identifying components and allow extra time.
- Appoint a ‘safety monitor’ and ‘buddy system’
- Teachers will consult individual student IEPs for specific direction on accommodation for individuals.

Resources

Print

Norton, Peter. *Introduction to Computers*, 3rd ed. New York: Glencoe/McGraw-Hill, 1999.

Smyth, Graham and Christine Stephenson. *Computer Engineering: An Activity-Based Approach*. Toronto: Holt Software Associates, 2000. ISBN 0-921598-36-X

Video

The Journey Inside. Intel Corporation. Part of *The Journey Inside Education* kit
Contains two videos, an instructional binder, and electronic components.

Websites

How Things Work – <http://howthingswork.com>

Novell Network Primer – <http://www.novell.com/catalog/primer/primer.html>

Turing and OOT – <http://www.holtsoft.com/turing/resources.html>

ABRA Electronics – <http://www.abra-electronics.com>

Inside a computer – <http://secure.wesweb.com/intel/form.htm>

Appendix 1.1.1

Sample Log Book

The following log is a sample template for students to track their progress.

Date	System	Problem/Activity	Research	Solutions/Application

Appendix 1.1.2

Glossary of hardware terms

Component	Function
Central Processing Unit (CPU)	
BIOS (in ROM)	
SIMMs, DIMMs, RAM	
ISA	
PCI Slot	
Power Supply	
Floppy Drive	
Hard Drive	
CD-ROM Drive	
Parallel Port	
Serial Port	
Graphics Port	
USB Port	
Com2 Port	
Keyboard Port	
IDE Cable	
CMOS Battery	

Appendix 1.1.3

Sample Computer Disassembly Log sheet

Entries in the Image (Drawing) column may be neatly hand drawn, retrieved from one of the reference Websites, or cropped/copied/pasted from various sites. (See **Note Concerning Permissions** in the Overview Resources.)

Component	Label or Identification	Location (in case or mb)	Orientation (IC's, cables, etc.)	Connections (to other parts)	Image (Drawing)

Appendix 1.1.4

Computer Safety Worksheet

1. What tools should you have on your worktable before beginning to work on any computer?
2. What characteristic should a tool not have when working on a computer?
3. What special process is required before handling electronic circuit boards or ICs?
4. What type of footwear is most suitable for working on a computer?
5. What type of clothing **must be avoided** when working on a computer?
6. Describe how electronic devices and computer circuit boards must be handled.
7. Name two special considerations when choosing cleaning agents for computer components.
8. Why is it important not to eat or drink in the computer lab?
9. What is the procedure to follow if chemicals get into your eyes?
10. Why is it **always important** to record settings and configurations before changing them?
11. Explain how you would 'backup' a file. Why is that important? How would you create a 'backup'?
12. Why would a 'bootup' or 'system boot' disk be important? How would you prepare one?

Appendix 1.1.5

Computer Assembly and Disassembly Test

1. List three safety precautions to be observed when assembling or disassembling a computer.
2. List the steps in disassembling a computer.
3. Describe the manner to correctly remove the CPU (in a ZIF socket).
4. Describe the manner to correctly remove the CMOS chip.
5. Describe the correct manner to handle circuit boards.
6. How is a video card correctly installed?
7. What is the primary difference when inserting cards into ISA versus PCI slots?

Appendix 1.1.6

Rubric Assessing use of correct terminology, components and safety related to components

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
Knowledge/ Understanding Application Terminology demonstrates ability to use appropriate terminology to identify the components and their function	- limited ability to use appropriate terminology to identify the components and their function	- some ability to use appropriate terminology to identify the components and their function	- considerable ability to use appropriate terminology to identify the components and their function	- a high level of ability to use appropriate terminology to identify the components and their function
Knowledge/ Understanding Communication Internal components demonstrates ability to identify and describe the function of micro computer components	- limited ability to identify and describe the function of micro computer components	- some ability to identify and describe the function of micro computer components	- considerable ability to identify and describe the function of micro computer components	- a high level of ability to identify and describe the function of micro computer components
Knowledge/ Understanding External components demonstrates ability to identify and describe the function of external components	- limited ability to identify and describe the function of external components	- some ability to identify and describe the function of external components	- considerable ability to identify and describe the function of external components	- a high level of ability to identify and describe the function of external components
Knowledge/ Understanding Peripherals demonstrates ability to identify and describe the function of peripheral components	- limited ability to identify and describe the function of peripheral components	- some ability to identify and describe the function of peripheral components	- considerable ability to identify and describe the function of peripheral components	- a high level of ability to identify and describe the function of peripheral components

Appendix 1.1.6 (Continued)

<p>Knowledge/ Understanding Application Thinking/Inquiry Safety demonstrates ability to follow recognized safety procedures when working with electrical current</p> <p>demonstrates ability to apply appropriate methods to ensure grounding</p> <p>demonstrates ability to use specific tools for tasks</p>	<p>- limited ability to follow recognized safety procedures when working with electrical current</p> <p>- limited ability to apply appropriate methods to ensure grounding</p> <p>- limited ability to use specific tools for tasks</p>	<p>- some ability to follow recognized safety procedures when working with electrical current</p> <p>- usually applies appropriate methods to ensure grounding</p> <p>- some ability to use specific tools for tasks</p>	<p>- considerable ability follow recognized safety procedures when working with electrical current</p> <p>- considerable ability to apply appropriate methods to ensure grounding</p> <p>- considerable ability to use specific tools for tasks</p>	<p>- a high level of ability to follow recognized safety procedures when working with electrical current</p> <p>- a high level of ability to apply appropriate methods to ensure grounding</p> <p>- a high level of ability to use specific tools for tasks</p>
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Note: A student whose achievement is below level 1 (50%) has not met the expectations for this assignment or activity.

Activity 2: Computer Assembly and Testing

Time: 480 minutes

Description

Students develop the skill to properly handle computer components, correctly assemble computer systems, configure the fixed disk in a computer system, and prepare it for an operating system. Students build upon the knowledge and skills introduced in Activity 1 so they can reassemble and test a computer system. This activity allows the students to develop the required skills and problem solving processes to eventually independently troubleshoot, recommend computer configurations, and meet an identified need in the final activity.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes

Overall Expectations

TFV.01 - describe current hardware and software products;

TFV.03 - identify required procedures for the safe handling of electronic components.

Specific Expectations

TF1.02 - explain the function of computer peripherals (e.g., mouse, keyboard, screen, printer, multimedia devices);

TF1.11 - explain the correct procedure for handling components that use electrical power;

SP1.03 - properly set up and configure computer systems;

SP1.13 - maintain a glossary of computer terms and acronyms.

Prior Knowledge & Skills

- Hardware and peripheral familiarization from Activity 1
- Personal computer skills learned from general use of a computer

Planning Notes

- A distinction is made here between an operating system and a platform: DOS being the OS and Windows being an example of a platform. If an older system is used, one without a CD-ROM for instance, it is advisable to use DOS 6.22 and Windows 3.1.
- Inventory the hardware available for any hands-on or demonstrative activities.
- Test equipment required for demonstrations and student activities. Experienced students may assist in the testing procedure and equipment setup.
- Ensure students remove acrylic or wool sweaters before handling components of computers.
- Ensure students discharge themselves before handling components or computers.
- Prepare a lesson on magnetic and optical storage devices and how they operate.
- Prepare a lesson on the need for and the procedure of formatting a disk, including notes on Partitions, Boot Sector, File Allocation Table, Root Directory, and Data Area. A review of bits and bytes may be in order before discussing storage capacity.
- Copies of Appendix 1.2.1 – Hard drive glossary of terms.

Teaching/Learning Strategies

1. Review the safety considerations when working with computer internals and with electronic components.
2. Hand out a copy of the Glossary of Terms (Appendix 1.2.1). As students progress through this activity, they fill in the definitions for each of the terms listed. This is submitted for evaluation at the end of the activity.
3. After teaching a lesson on magnetic and optical storage devices (operation, access time, transfer rate, speed), students research the Internet and do a comparison of various devices, by brand name and capacity rating. Students include such devices as Hard Drives, CD-ROM, CD-R/W, and DVD. This chart is kept as part of their portfolio. See Appendix 1.2.3.
4. Students re-assemble the computer either individually or in groups. A peer evaluation/inspection is completed. If inspection is passed, students boot the computer, and observe/log the boot sequence looking for errors or inconsistencies.
5. If the boot-up was not successful, students record any error message that was generated by the computer and write down their observations. They then proceed to trouble-shoot.
6. Once system has booted correctly and is working, students proceed in developing a troubleshooting process with the introduction of ‘controlled faults.’ These controlled faults are the removal of items in the computer (CPU, RAM, etc.) and the logging of observed computer problems and error messages. A table as in Appendix 1.2.7 would be completed.
7. Upon successful boot-up various tests are conducted: boot-up without keyboard, without a video card, without RAM, or ribbons connected to the wrong pin configuration (on hard drive or floppy drive). Students write down their observations and any error messages the computer generates. This becomes part of their trouble-shooting guide. This task could be more structured to ensure it results in meaningful activity.
8. After a lesson on the types of interface (IDE, ESDI, SCSI), students continue their research on the Internet and complete the cost comparison chart.

Assessment & Evaluation of Student Achievement

- The purpose of the assessment is to see if students are using the tools safely and properly as well as to see if the students are able to assemble a computer. Therefore, assessment should be done throughout this activity. Students are assessed at the end this activity with a quiz on terminology and procedures (Appendix 1.2.6).
- The Hard Drive Worksheets are to be completed and assessed to ensure students are able to identify the part of a hard drive and basic operating principles (Appendix 1.2.4, 1.2.5).
- A rubric may be used to assess the appropriate use of terminology and ability to prepare a hard drive.

Accommodations

- Students with physical dexterity problems assemble a computer by directing a peer to install a component in a particular location.
- Have a ‘shop computer’ available for students to practise alignment of male/female plug-ins or connectors and learn to recognize symbols to aid in the assembly of components (e.g., trapezoidal shape of plug-ins, international symbols).

Resources

Print

Norton, Peter. *Introduction to Computers*. 3rd. ed. New York: Glencoe/McGraw-Hill, 1999.
Smyth, Graham and Christine Stephenson. *Computer Engineering: An Activity-Based Approach*.
Toronto: Holt Software Associates, 2000. ISBN 0-921598-36-X

Video

The Journey Inside. Intel Corporation. Part of *The Journey Inside* Education kit
Contains two videos, an instructional binder, and electronic components.

Appendix 1.2.1

Sample Template for Hard Drive Glossary of Terms

Terms	Definition
Access Time	
Boot Record	
Cluster	
Cylinder	
Data Area	
Data Transfer Rate	
Directory	
ESDI	
FAT	
Formatting	
Hard Disk	
IDE	
Land	
Magnetic Storage	
Pit	
Read/Write Head	
Sector	
Track	

Appendix 1.2.2

Assessing terminology and preparation of hard drive

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
Knowledge/ Understanding Terminology	- limited ability to use appropriate terminology to identify storage devices and its function	- some ability to use appropriate terminology to identify storage devices and their function	- considerable ability to use appropriate terminology to identify storage devices and their function	- a high level of ability to use appropriate terminology to identify all storage devices and their function
Application Thinking/Inquiry Preparing the hard drive	- limited ability to follow recognized procedures for preparing a hard drive	- some ability to follow recognized procedures when preparing a hard drive	- considerable ability to follow recognized procedures when preparing a hard drive	- a high level of ability to follow recognized procedures for preparing a hard drive

Note: A student whose achievement is below level 1 (50%) has not met the expectations for this assignment or activity.

Appendix 1.2.3

Storage Medium Comparison Chart

Device					
Magnetic/ Optical	Interface	Capacity in Mb/Gb	Transfer Rate in Mb/Sec	Seek time in msec.	Price (optional)

Appendix 1.2.4

Hard Drive Worksheet 1

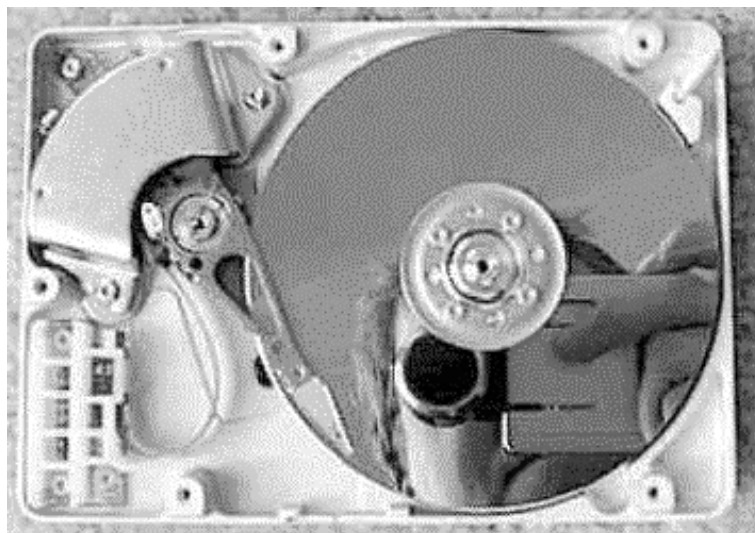
During hard drive disassembly, complete the following table for all the hard drive components, in each category.

Hard Drive Component	Image/diagram	Connections	Function
R/W head			
Head Actuator motor			
Platter			
Spindle			
Spindle motor			
R/W head arm			
R/W head arm pivot			
Cast casing			
Air filter			
Data connector			
Power connector			
RPM detector			

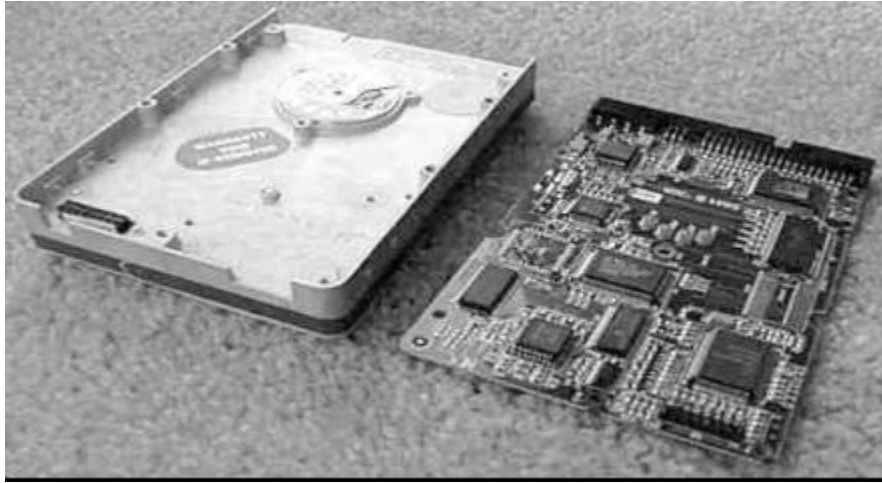
Appendix 1.2.5

Hard Drive Worksheet II

Label the parts of a HARD DRIVE on the following pictures (add arrows to indicate specific parts)



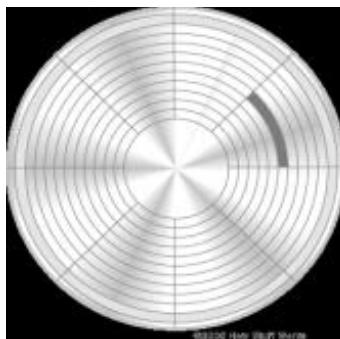
Appendix 1.2.5 (Continued)



Appendix 1.2.6

Quiz

- 10/ 1. What does DATA RATE mean? Compare 3 types of hard drives for their data rates noting the major identifying characteristic.
- 10/ 2. What is meant by SEEK TIME? Compare 3 types of hard drives for their seek times noting the major identifying characteristic.
- 4/ 3. A HARD DRIVE spinning at 7200 RPM is comparable to what land speed?
- 4/ 4. What is a FILE? How is it identified on the HARD DRIVE?
- 4/ 5. What does the term CAPACITY mean? Provide a simple formula to determine the CAPACITY.
- 8/ 6. What is the following? Label all the elements correctly.



- 6/ 8. Explain the term PARTITIONING. How would you perform this task on a hard drive?

Appendix 1.2.7

Boot sequence fault analysis

Item removed	Fault detected or observed
CPU	
RAM	
ROM (CMOS)	
Hard drive	
HD cable reversed	
Floppy drive	
FD cable reversed	
HD controller	
Video card	
Keyboard	
Mouse	

Activity 3: Computer Upgrading

Time: 240 minutes

Description

Students are given the opportunity to upgrade a computer system, to install an operating system and application software, and to optimize the performance of the computer system. The activity is set up as a repair shop/customer service area of a computer store. Students take on the role of both repair technicians and customers. As customers, students specify the application of the computer. As technicians, students recommend the appropriate hardware, operating system, and software to meet the needs of the customer.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes

Specific Expectations

TF1.04 - identify current software products, their uses, and their hardware requirements;

TF1.05 - specify criteria for the selection of hardware;

TF1.06 - explain the hierarchical structure used to organize directories and files;

TF1.11 - explain the correct procedure for handling components that use electrical power;

SP1.02 - cost out computer systems accurately, including all components and peripherals;

SP1.08 - install and update virus-checking software;

SP1.09 - properly install and configure software upgrades;

SP1.11 - perform backup procedures effectively;

SP1.14 - prepare storage media for use;

SP2.04 - maintain service logs effectively using a database and/or word processor;

SP2.05 - develop installation and service procedures;

SP2.06 - demonstrate ability to follow peer-developed installation or service procedures.

Prior Knowledge & Skills

- Hardware and peripheral familiarization from Activities 1 and 2
- Ability to develop and follow instruction sheets and maintain logs developed in Activities 1 and 2
- Personal computer skills learned from general use of a computer

Planning Notes

- Collect flyers and brochures from computer stores, advertising computer systems with different configurations.
- Prepare of a variety of upgrade or add-on cards such as video, sound, modem, scsi (these upgrades do not need to be the very latest technology – this simulation exercise can be successful with parts from 486 models).
- Check availability of licensed software (see previous comments).
- Research local repair costs and labour costs for computer systems.
- Create scenarios with various computing needs such as:
 - a system that allows the user to do word processing, e-mail/Internet research, network conferencing;
 - a system that allows the user to do 3-D image creation and editing;
 - a system used by a small business that allows the user to do accounting, produce invoices, e-mail, produce advertising materials.

Teaching/Learning Strategies

1. Hand out copies of advertising flyers. Discuss the various computer systems, configurations, prices, and warranties available.
2. Have the students research websites of computer resellers to verify specifications and costs of systems and components.
3. Present students with different scenarios (Appendix 1.3.1) In groups, the students identify the characteristics of the system to meet a particular need.
4. Have the students conduct a comparison of purchasing complete systems vs. purchasing components to build a custom system to meet specific customer needs.
5. Encourage students to keep a journal in which they enter the steps of installing these components, as well as any problems they encounter and the solutions required.
6. Students should have an opportunity to install such components as mice, printers, soundcards, modems, and, where possible, different types of video cards on 'shop computers.'
7. Students recommend an operating system, virus checking software, and application software packages to meet the needs of the customer (Appendix 1.3.2).

Assessment & Evaluation of Student Achievement

Student ability to recommend a computer system and appropriate software is assessed using a rubric (Appendix – 1.3.3) and the proposal evaluation form (Appendix – 1.3.4).

Accommodations

- Have a variety of communication accommodations available for students who have difficulty expressing themselves in a verbal format, such as, signing, bliss board, etc. Consult with the Special Education resource department to ensure that the accommodations are appropriate to the exceptionalities of particular students.
- Check the students' OSR and IEP to effectively provide suitable accommodations specific to the needs of the student.
- Allow time for students with difficulties (e.g., nervousness) to develop presentation skills and ensure that such students are paired with individuals that are sensitive and can assist in the presentation.

Resources

Print

Glover, Thomas J. and Millie M. Young. *Pocket Pcref*, 10th ed. Sequoia Publishing, 2000.

ISBN 1-885071-27-2

Minasi, Mark. *The Complete PC Upgrade and Maintenance Seminar In A Box*. SYBEX, 2000.

ISBN 07821-2706-1

Websites

Websites of the Board's computer provider

Computer assembly sites – <http://oakroadsystems.com/tech/hd-partn.htm>

<http://www.pcmech.com/build.htm>

Operation of computer and components – <http://www.karbosguide.com/index2.htm>

ABRA Electronics – <http://www.abra-electronics.com>

Appendix 1.3.1

Meeting Customer Needs

Research the system that you recommend to the clients identified below:

CLIENT “A”- snowbird

- Not computer literate and would like to create personal letters and customized cards
- Communicates electronically with family in another province
- Resides six months of the year in Ontario and six months in Florida
- Visually challenged
- Budget - \$1700

CLIENT “B”- starting a home based business

- Requires the ability to send and receive faxes
- Regularly checks customer websites
- Produces ‘legal quality’ contracts on legal size paper
- Does own accounting
- Creates cheques and invoices
- Electronically stores large customer files
- Produces own marketing materials
- Budget - \$2500

CLIENT “C” travelling sales representative

- Works out of vehicle
- Travels nationally
- Needs to create transferable files
- Sends and receives information (text and drawings)
- Requires navigating system
- Required to produce “legal quality” documents
- Requires portable power considerations
- Required to input and transmit digital images
- Likes to watch movies when on the road
- Budget – dependent upon return on investment

Appendix 1.3.2

Recommendation Form

Item	Specifications	Cost	Ease of use (1-4, 1 being the most difficult)
Internal Components			
External Components			
Peripherals			
Operating system			
Application Software			
Virus checker and security			
Energy considerations			
Durability considerations			

Appendix 1.3.3

Rubric to assess upgrading and software installation

Criteria	Level 1 (50-59%)	Level 2 (60-69%)	Level 3 (70-79%)	Level 4 (80-100%)
Communication Application Upgrading	- limited ability to recommend upgrades that meet client needs	- some ability to recommend the upgrades that meet client needs	- considerable ability to recommend the upgrades that meet client needs	- a high level of ability to recommend the upgrades to meet client needs
Application Installing and configuring software	- limited ability to follow recognized procedures for installing software	- some ability to follow recognized procedures when installing software	- considerable ability to follow recognized procedures when installing software	- a high level of ability to follow recognized procedures when installing software

Note: A student whose achievement is below level 1 (50%) has not met the expectations for this assignment or activity.

Note: Each category can be assessed on separate short sight passages over a period of time. Using the same rubric, the student's progress can be recorded and measured, from diagnostic to formative to summative evaluation, using different colours for each assessment. The length of the sight passage may be more than one or two pages, as long as the length and level of difficulty are consistent among assessments.

Appendix 1.3.4

Proposal Assessment Chart

(1= limited, 2= moderate, 3= considerable, 4= thorough)

Criteria	1	2	3	4
Evidence of Thorough Research				
Contribution to Group				
Multimedia Use and Presentation				
Meets Client Needs				

Unit 3: Networking

Time: 20 hours

Description

This unit focuses on basic network components, network cables, network types, and topologies. Students install network cards, activate computer operating systems for network access, install and configure computers for given network operating systems, and define computer network interfaces. They learn the importance of network connectivity and infrastructure (dial-up, LAN, WAN, and Internet) and how it impacts on our world, as well as potential career opportunities in the area of computer networking. Importance of proper and documented communications is stressed when dealing with customer requests. Students practise attitudes and values founded on Catholic social teaching when dealing with clients.

Unit Synopsis Chart

Activity	Time	Expectations	Assessment	Tasks
1. Networking Components and Networks	180 min	TFV.01, TFV.02, TF1.01, TF1.07, TF1.09, SP2.01, ICV.04 CGE2b, CGE2e, CGE3b, CGE3c	Knowledge/ Understanding	General networking concepts, hardware, and historical developments.
2. Network Interface Card Installation and OS Activation	180 min	TFV.02, TFV.03, TF1.01, SPV.02, SP1.05, SP1.10, SP2.01, ICV.04 CGE3b, CGE3c, CGE4f	Thinking/ Inquiry Application	NIC installation and activation on a PC. Tests for successful configuration.
3. Communicating on a Network – Network Assembly and Protocols	180 min	SPV.02, SP1.03, SP1.10, SP2.01, ICV.04 CGE3b, CGE4f	Thinking/ Inquiry Application	Configuring a network using networking electronics and cables.
4. Install and Configure Networks Based on Client Needs	420 min	TFV.01, TFV.02, TF1.01, SPV.03, SPV.05, SP1.01, SP1.02, SP1.03, SP1.12, SP1.15, SP2.01, SP2.05, SP2.06, ICV.02, ICV.04, IC1.02, IC1.04, IC1.05 CGE3b, CGE3c, CGE4c, CGE5e	Knowledge/ Understanding Thinking/ Inquiry Communication Application	Assessing, formulating, implementing and documenting of networks based on client needs. Career exploration
5. Network Troubleshooting	240 min	TF2.02, SPV.01, SPV.02, SPV.05, SP1.04, SP1.06, SP1.07, SP2.01, SP2.04, SP2.05, ICV.02, ICV.03, ICV.04, IC1.03, IC1.04, IC1.05 CGE3b, CGE3f, CGE4f, CGE5a	Thinking/ Inquiry Communication	Developing logical diagnosis and problem documentation procedures.

Activity 1: Networking Components and Networks

Time: 180 minutes

Description

Students are introduced to basic network hardware components including hubs, switches, routers, bridges, cabling, network interface cards, home dial-up equipment and their associated functions. The basic setup of a network is discussed and performed in a controlled working environment. Students demonstrate understanding of simple home networks including dial-up services. Importance of proper and documented communications is stressed when dealing with customer requests. Students also focus on customer service ideals, and examine the meaning of a moral and ethical work environment.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes, Impact and Consequences

Overall Expectations

TFV.01 - describe current hardware and software products;

TFV.02 - describe computer networks and operating systems;

ICV.04 - communicate and work effectively individually and in groups.

Specific Expectations

TF1.01 - identify current hardware products and their uses;

TF1.07 - describe the advantages and disadvantages of networked versus stand-alone computing;

TF1.09 - explain the similarities and differences between local and wide area networks;

SP2.01 - use computer terminology correctly.

Ontario Catholic School Graduate Expectations

CGE2b - reads, understands and uses written materials effectively;

CGE2e - uses and integrates the Catholic faith tradition, in the critical analysis of the arts, media, technology, and information systems to enhance the quality of life;

CGE3b - creates, adapts, evaluates new ideas in light of the common good;

CGE3c - thinks reflectively and creatively to evaluate situations and solve problems.

Prior Knowledge & Skills

- Basic hardware familiarization from Unit 1
- An understanding of the basic functions of the operating system. This would include an understanding of how to copy/delete/rename files, format data and bootable diskettes, and locate various hardware controls in the operating system.
- A clear understanding of the safe handling of computer hardware from Unit 1.

Planning Notes

- Pretest hardware including network cabling, telephone line (if available) and network drops (if available).
- Test for connectivity of computers on the networks for demonstration purposes (e.g., pinging different workstation IP addresses)
- Determine the date of the assessment for this activity and inform students at the beginning of the activity.
- Determine the terms and concepts to be assessed at the end of this activity and plan an evaluation scheme appropriate for the class ability level.
- Prepare lesson presentation of topologies, architecture, network types and cabling standards (Appendices 2.1.3 – Networks).

-
- Organize the distribution of hardware for student handling purposes.
 - Determine if alternative resources are required or may be of benefit for this activity (e.g., guest speakers, field trips, web tours).

Teaching/Learning Strategies

1. (Day 1) Teachers discuss the concept of serving customers and the common good in applying networks to enhance business and education opportunities. The priority of striving to improve life is discussed, students are asked to record this in their journals. Teacher and students discuss concepts of connectivity using SneakerNet (copying files onto a disk then walking it to another computer) up to and including the Internet. The focus is the benefits to customers of LAN and/or WAN.
2. Teachers demonstrate various networking hardware components and discuss the function of each, preferably with simple workgroup sharing (e.g., Windows Workgroups or Macintosh Appleshare file sharing – using both serial/parallel connections as well as LAN hardware), LAN connectivity (i.e. link status activity indicators on hubs), and/or dial-up devices (e.g., 56K and/or DSL/Cable modems). Note that a discussion of the type of cabling (CAT3 and CAT5 UTP, cross cables) and the connectors (RJ11 and RJ45) may be inserted here if level of understanding and time permit.
3. Teachers introduce the Connectivity Report question sheet and accompanying rubric, provide resources for students and assign due date. (Appendix 2.1.1 – Positives and Negatives of Connectivity for home users).
4. (Day 2) Teachers demonstrate how to connect two computers using a simple serial or parallel cable (e.g., ADB cable and the Chooser on a Macintosh) then how to do the same transfer using LAN connections.
5. Students work as a team to connect two computers using a parallel/serial cable and using appropriate operating system utilities. Using the checklist they created during the teacher demonstration, students check their machines for connection success and troubleshoot any difficulties. Students make a checklist during the demonstration and make a connection using operating system utilities and transfer a file.
6. Teachers circulate to assist students with any problems. Students complete their checklist to add to their portfolio.

Assessment & Evaluation of Student Achievement

- Learning Skills Checklist
- A formative assessment by observing the completion of the activities and roving conferences to indicate student progress and areas in need of improvement. Use the Networking Activity Checklist and Rubric to assist in this formative assessment (Appendix 2.1.4).

Accommodations

- Provide vocabulary and definitions prior to and in the course of the lesson, when necessary.
- Monitor individual submissions; allow extra time or alternative assignments as needed.
- Provide extra visual and hands-on assistance for students with special needs, based on recommendations in the exceptional student's IEP.

Resources

Software

Operating systems (e.g., DOS, Windows 9.x, Windows NT, Windows ME, Windows 2000, System 6.x, 7.x, 8.x, Unix, Linux, or others)

Ontario Educational Software Services [OESS software tools] (e.g., *Corel WordPerfect*, *Microsoft Works*, *Appleworks*, etc.)

Networking Utilities (e.g., ping, FTP, NetScanTools, AG EtherPeek, AGNet Tools, etc.)

Print

Feibel, Werner. *Encyclopedia of Networking*, 3rd ed. Sybex, 2000. ISBN 0-7821-2255-8

Feldman, Jonathon. *Sams Teach Yourself Network Troubleshooting in 24 Hours*. Sams, 1998. ISBN 0672314886

Gregg, Kenneth. *Windows Networking Basics*. Harper Collins Canada, 1998. ISBN 0764532146

Groth, David and Jim McBee. *Cabling The Complete Guide to Network Wiring*. Sybex, 2000. ISBN 0-7821-2645-6

Kearns, Dave. *Sams Teach Yourself Windows Networking in 24 Hours*. Sams, 1998. ISBN 0672314754

Keogh, Jim. *Core MCSE: Networking Essentials*. Prentice-Hall of Canada Ltd. ISBN 0130107336

Magendanz, Thomas and Radu Popescu-Zeletin. *Intelligent Networks: Basic Technology, Standards & Evolution*. International Thomson Press, 1996. ISBN 1850322937

Minasi, Mark. *The Complete PC Upgrade and Maintenance Guide*. Sybex 2000. ISBN 0-7821-2800-9

Networking Complete. Sybex, 2000. ISBN 0-7821-2610-3

Operating System Manuals and reference texts

Sybex A+ e-Trainer. Sybex, 2000. ISBN 0-7821-5000-4

Video

The Journey Inside

Intel Corporation – Part of *The Journey Inside Education Kit*

Websites

Tim Higgin's Practically Networked – <http://www.practicallynetworked.com/>

Novell Network Primer – <http://www.novell.com/catalog/primer/primer.html>

Intel Resources – <http://www.intel.com/education/k12/resources/index.htm>

3Com's Netprep programme – <http://education.3com.com/Netprep/index.html>

Computer Professionals for Social Responsibility – <http://www.cpsr.org/>

Business Ethics Magazine – <http://www.business-ethics.com/>

Appendix 2.1.1

Positive and Negative Aspects of the Evolution of Connectivity

Question Sheet

1. How and why did computer connectivity develop?
2. What are some of the advantages of connectivity? Discuss using the following applications.
 - personal communication
 - business communication
 - collaborative processors
 - marketing
 - development of software
 - exchange of ideas
3. What are some of the disadvantages of connectivity? Discuss using the following applications.
 - personal communication
 - business communication
 - collaborative processors
 - marketing
 - development of software
 - exchange of ideas
4. In your opinion, what is the greatest advantage/disadvantage of connectivity in an educational setting?

Appendix 2.1.3

Network Basics

Definition: Network – Two or more communicating devices that are connected to form a system that share applications, data, and hardware components.

Purposes

- share resources
- speed connections between computers
- research collaboration
- electronic mail
- teleconferences and discussion groups
- cooperative learning

LANs

- LAN: local area network – computers networked within the same site.
- Nodes: Devices that are connected to the network.
- Servers – computers and devices that provide services on a network (e.g., file servers, print servers, web servers).
- Cables:
 - Twisted Pair Cable: costs the least but is the slowest and can be affected by electromagnetic interference (EMI) from electrical devices (e.g., photocopiers, fluorescent lights, etc.);
 - Coaxial cable: can be baseband and broadband. Baseband can only carry one signal, but is very fast. Broadband can carry more than one signal;
 - Fibre Optic Cables: can carry massive amounts of data and are unaffected by magnetic or electrical interference. They are expensive and difficult to install.
- Network Interface card: an adapter card placed inside the computer in either a PCI or ISA slot. It is the connection on the computer to the network.
- Hubs (sometimes called repeaters or concentrators) distribute/broadcast network signals equally down all ports regardless of actual destination address.
- LAN switches: distribute signals from source to destination without broadcasting to other ports. This prevents collisions and is a more efficient use of bandwidth.
- Router: a device that connects any number of LANs. Routers use headers and a forwarding table to determine where packets go and they use ICMP to communicate with each other and configure the best route between any two hosts. Very little filtering of data is done through routers.
- Bridge: a device that connects two LANs or two segments of the same LAN. The two LANs being connected can be alike or dissimilar. Unlike routers, bridges are protocol independent.

Topology

Physical layout of LAN: most common are:

- BUS: least expensive because it does not require hubs or switches as all nodes connected to LAN as branches on a common line.
 - Requires network cards installed in nodes.
 - Failure of one computer can bring down the network if the common line is broken and not terminated.
- STAR: requires hubs or switches.
 - All nodes attached have a separate line connected to a hub or switch.
 - If one computer fails in any way the network will still function, i.e., this topology is more fault tolerant.

Appendix 2.1.3 (Continued)

- RING: all nodes are on the same circuit forming a continuous loop (e.g., Token Ring or FDDI).
 - If ring is broken, network fails.
 - Ring technologies are typically controlled access networks, which means that they use the full bandwidth of the technology at all times. Very fast and efficient but also very expensive.

LAN Architecture

- Client/server: uses one or more computers as servers and other computers are clients;
 - server contains the network operating system capable of providing services (e.g., file, print, web, FTP, application, etc.);
 - clients can request those services (e.g., save files, run programs, or print on a network printer).
- Peer/Peer - all computers on network are considered equal citizens. At any time a computer can provide services or be using services from another computer. Typically used on small networks due to management issues.

Network Communication

WAN – wide area networks – computers connected between two physically different sites using telephone lines, cable, radio waves, or other telco service.

- requires special media provided by service providers (e.g., Bell, Rogers).
- requires special hardware:
 - telephone wires, fibre optic cables, microwaves or satellites required for communication;
 - routers decide where to send data;
- Internet is very large example of a WAN.

Network Protocols

- Set of rules for exchanging information between different formats.
- Assists in transferring files between microcomputers.
- When different formats meet and decide on a common means of communication it is called handshaking.
- Protocol converters help change information between incompatible formats.
- TCP/IP is one of the most common protocols (Transmission Control Protocol/Internet Protocol).
- NETBEUI, IPX/SPX, Appletalk, NetBIOS over IPX/SPX
- DHCP and DNS servers, Gateways

Appendix 2.1.4

Networking Activity Checklist – (If yes is selected indicate level based on rubric)

Activity	Networking Terminology Used		Physical Connection of Computers		Quality and Use of checklist		Operating System Setup		File Transfer and troubleshooting	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Student Names										

Activity 2: Network Interface Card Installation and OS Activation

Time: 180 minutes

Description

Students perform Network Interface Card (NIC) installations within common operating systems (e.g., MacOS 9, X, Windows 95/98/NT/ME 2000, Linux, etc.). Students perform physical installations using safe operating procedures, activate the new device in the operating system (OS) and test for connectivity using basic utility software (e.g., ping). Students apply ethical teamwork and customer service practices as members of a team.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes, Impact and Consequences

Overall Expectations

TFV.02 - describe computer networks and operating systems;

TFV.03 - identify required procedures for the safe handling of electronic components;

ICV.04 - communicate and work effectively individually and in groups.

Specific Expectations

TF1.01 - identify current hardware products and their uses;

SPV.02 - use utility and application software effectively;

SP1.05 - properly install and configure expansion components (e.g., video/network/modem cards, memory, secondary storage devices);

SP1.10 - use appropriately prescribed methods of handling computer hardware;

SP2.01 - use computer terminology correctly.

Ontario Catholic School Graduate Expectations

CGE3b - create, adapt, and evaluate new ideas in light of the common good;

CGE3c - think reflectively and creatively to evaluate situations and solve problems;

CGE4f - apply effective communication, decision-making, problem-solving, time and resource management skills.

Prior Knowledge & Skills

- Hardware familiarity from Unit 1
- An understanding of the basic hardware functions of the operating system. This would include the use of a device manager to determine hardware conflicts.
- A clear understanding of the safe handling of computer hardware from Unit 1

Planning Notes

- Pre-test connectivity between devices to determine if cables and network devices are working.
- Pre-test computer configuration to determine if all computers are operating correctly, establish phone line connectivity (i.e., dial tone) and modem configuration on the demonstration computer.
- Prepare appropriate hardware to facilitate the installation of NICs (a station approach can be used in a limited hardware situation).
- Review prepared step-by-step handouts and complete steps according to the work site.
(Appendix 2.2.1 – Installing Network Interface Card)

Teaching/Learning Strategies

- Teachers and students review safety concerns with static electricity and the importance of keeping contacts clean as they apply to components.
- Teachers introduce the activity with a discussion about connectivity to the Internet focusing on the concepts of direct and dial-up connectivity. Students review handout (Appendix 2.2.1 – Installing a Network Interface Card Checklist). Students follow the checklist as the teacher demonstrates:
 - the installation of a NIC;
 - the installation of a driver to activate the NIC;
 - the connection to a network using an appropriate cable;
 - illustration of link status indicators to show that the NIC was successfully activated;
 - installation of an appropriate network protocol;
 - connection to a network and how to test for successful connectivity.
- Students follow the instructions given (Appendix 2.2.1 – Installing a Network Interface Card Checklist) in groups as defined by the teacher. Teachers assist with problems that arise. Students are required to fill in terminal logs or customer service sheets to record changes made to the computers.
- Students and teacher discuss the difference between a direct connection to a LAN and dial-up networking via a modem (Dial-up can be a teacher demonstration). Students illustrate the similarities and differences between these two types of connection and how dial-up/home connectivity is evolving (i.e., DSL/Cable modems, home networks, routers) as students complete the worksheet. (Appendix 2.2.2 – Evolution of Connectivity).
- If time permits, it would be appropriate at this point to discuss the types of network connections to the Internet (Dial-up, Cable, DSL, ISDN, T1/T3) and the ways that different types of network (home or business) interact with the Internet connection, (e.g., proxy servers, multiple IP addresses, routers, etc.).

Assessment and Evaluation of Student Achievement

- Learning Skills Checklist
- A formative assessment by observing the completion of the activities and roving conferences to indicate student progress and areas needed for improvement
- Grading of completed checklist (Appendix 2.2.1)

Accommodations

- Establish level of difficulty of tasks for individual students, based on previous observations.
- Provide one-on-one teaching as required.
- Provide peer helpers as required
- Provide extra visual and hands-on assistance for students with special needs based on recommendations in the exceptional student's IEP.

Resources

Software

Operating systems (e.g., DOS, Windows 9.x, Windows NT, System 6.x, 7.x, 8.x, Unix or others)

Ontario Educational Software Services [OESS software tools] (e.g., *Corel WordPerfect*, *Microsoft Works*, *Appleworks*, etc.)

Networking Utilities (e.g., ping, FTP, NetScanTools)

Print

Gregg, Kenneth. *Windows Networking Basics*. Harper Collins Canada, 1998. ISBN 0 764532146

Kearns, Dave. *Sams Teach Yourself Windows Networking in 24 Hours*. Sams, 1998. ISBN 0 672314754

Minasi, Mark. *The Complete PC Upgrade and Maintenance Guide*. Sybex 2000. ISBN 0-7821-2800-9
Networking Complete. Sybex, 2000. ISBN 0-7821-2610-3

Operating System Manuals and reference texts

Sybex A+ e-Trainer. Sybex, 2000. ISBN 0-7821-5000-4

Websites

3Com Network Interface Support Documents – <http://support.3com.com/infodeli/tools/nic/index.htm>

D-Link Support Documents – <http://www.dlink.com/tech/resources/>

Appendix 2.2.1

Installing a Network Interface Card

Names of Team members:	
Instructions	Completed
1. Check to see if all appropriate hardware and tools are ready.	
2. Attach a ground cable to your wrist and ground yourself to the computer chassis.	
3. Disconnect all cables from the computer.	
4. Open the computer chassis.	
5. Check for open slots (identify slot types).	
6. Identify the slot you are going to use for the NIC.	
7. Remove the slot cover.	
8. Retrieve the appropriate NIC for the slot you selected (make sure slot type and NIC selected are compatible).	
9. Put the NIC in the slot by putting the back end in first and then slowly rock the card forward.	
10. Using your fingers on the outside of the case, make sure that the card faceplate does not catch the end of the case.	
11. Firmly press the card in place then screw it in (card is seated correctly if there is no space between the bent part of the face plate and the chassis – ask your teacher to check this if you are unsure).	
12. Close the case.	
13. Reconnect all cables.	
14. Remove your ground wire.	

Installation instructions beyond this point vary significantly depending on the operating system.

Appendix 2.2.2

Evolution of Connectivity

Type of Connection	Speed	Description/Change	What it means to the client/end user
Modem			
ISDN			
Cable			
ADSL/HDSL			
Direct LAN			

Activity 3: Communicating on a Network – Network Assembly and Protocols

Time: 180 minutes

Description

Students set-up and test operations of simple networks using basic networking utilities. Students experiment with networking utilities in order to understand how to verify network connectivity using network protocols and testing tools. Students focus on providing customer service in the form of checking TCP/IP connectivity. The concept of the Catholic values of working toward the common good is reinforced through this activity.

Strand(s) & Learning Expectations

Strand(s): Skills and Processes, Impacts and Consequences

Overall Expectations

SPV.02 - use utility and application software effectively;

ICV.04 - communicate and work effectively individually and in groups.

Specific Expectations

SP1.03 - properly set up and configure computer systems;

SP1.10 - use appropriately prescribed methods of handling computer hardware;

SP2.01 - use computer terminology correctly.

Ontario Catholic School Graduate Expectations

CGE3b - create, adapt, evaluate new ideas in light of the common good;

CGE4f - apply effective communication, decision-making, problem-solving, time, and resource management skills.

Prior Knowledge & Skills

- Basic networking terminology
- Basic knowledge of safe use of tools and working on electrical systems should be reinforced throughout activity.

Planning Notes

- Check cables, network electronics and cable channelling for the activity.
- Pre-test any external network or modem connections as required.
- Consider pre-loading/pre-installing network utilities.
- Ensure all components are ready for students (i.e., cables, access to ports, etc.).

Teaching/Learning Strategies

1. Teacher and students review safety considerations when installing network components.
2. Teacher reviews indicators of connectivity based on hardware LEDs (e.g., link status and activity lights) to the class. Any questions are addressed at this time.
3. Teacher demonstrates various methods of testing connectivity (e.g., ping IP address, ping DNS name, mapping drives, using utilities, i.e., NetScanTools).
4. If connections have not been set-up, (as in previous activity), students connect systems based on a predetermined schema designed prior to the activity. Note that proper cable channelling is very important for safety reasons in both scenarios (i.e., cables should not be in areas where student could trip over them or get caught by them).
5. Students then test for connectivity. Simple pinging may be sufficient to conclude the activity or you may want to map drives using simple file sharing methods in the operating system.

Assessment and Evaluation of Student Achievement

- Students will be assessed formally with verbal questioning as they work through the activity.

Accommodations

- Group students for the best peer support scenario.
- Provide additional visual or hands-on assistance as required for students with special needs based on recommendations in the exceptional student's IEP.
- Provide (and discuss for reinforcement) all terminology with appropriate diagrams/photographs before the activity.
- Provide enhanced materials such as predetermined schema with instructions on the setup (e.g., connect a 10/100 switch to the 100Mbps hub using a cross cable, then connect the hub to the first workstation, etc.).

Resources

Software

Operating systems (e.g., DOS, Windows 9.x, Windows NT, System 6.x, 7.x, 8.x, Unix or others)
Ontario Educational Software Services [OESS software tools] (e.g., *Corel WordPerfect*, *Microsoft Works*, *Appleworks*, etc.)
Networking Utilities (e.g., ping, FTP, NetScanTools)

Print

Feibel, Werner. *Encyclopedia of Networking*, 3rd ed. Sybex, 2000. ISBN 0-7821-2255-8
Gregg, Kenneth. *Windows Networking Basics*. Harper Collins Canada, 1998. ISBN 0 764532146
Groth, David and McBee, Jim. *Cabling The Complete Guide to Network Wiring*. Sybex, 2000. ISBN 0-7821-2645-6
Kearns, Dave. *Sams Teach Yourself Windows Networking in 24 Hours*. Sams, 1998. ISBN 0 672314754
Networking Complete. Sybex, 2000. ISBN 0-7821-2610-3
Network+ Certification Study Guide. Syngress Media, Inc., 1999. ISBN 0-07-211846-6
Operating System Manuals and reference texts

Websites

Novell Network Primer – <http://www.novell.com/catalog/primer/primer.html>

Activity 4: Install and Configure Networks Based on Client Needs

Time: 420 minutes

Description

In this first of two culminating activities, students integrate and expand their knowledge of software, hardware theory and practice from the previous activities to build a network solution. Students follow a plan based on a customer need scenario, determining components and software required, with consideration of associated costs. Students develop strategies to provide ethical customer service, in light of Gospel values.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundation, Skills and Processes, Impact and Consequences

Overall Expectations

TFV.01 - describe current hardware and software products;
TFV.02 - describe computer networks and operating systems;
SPV.03 - determine user computing requirements;
SPV.05 - demonstrate professional customer service practices;
ICV.02 - identify skill sets required for the workplace;
ICV.03 - describe workplace opportunities;
ICV.04 - communicate and work effectively individually and in groups.

Specific Expectations

TF1.01 - identify current hardware products and their uses;
SP1.01 - recommend appropriate hardware and software based on user needs;
SP1.02 - cost out computer systems accurately, including all components and peripherals;
SP1.03 - properly set up and configure computer systems;
SP1.12 - use network resources to gather product information;
SP1.15 - design effective home computer set-ups, including technical and ergonomic considerations;
SP2.01 - use computer terminology correctly;
SP2.05 - develop installation and service procedures;
SP2.06 - demonstrate an ability to follow peer-developed installation or service procedures;
IC1.02 - identify social and computer skills that are important to employers;
IC1.03 - describe job opportunities in local business and industry;
IC1.04 - employ time management skills effectively in the completion of projects;
IC1.05 - effectively communicate the results of projects both orally and in writing.

Ontario Catholic School Graduate Expectations

CGE3b - create, adapt, and evaluate new ideas in light of the common good;
CGE3c - think reflectively and creatively to evaluate situations and solve problems;
CGE4c - take initiative and demonstrate Christian leadership;
CGE5e - exercise Christian leadership in the achievement of individual and group goals.

Prior Knowledge & Skills

- Hardware familiarity from Unit 1
- An understanding of the basic functions of various operating systems

Planning Notes

- Teachers develop a scenario requiring a networking solution.
- Prepare all hardware and software that may be used in the solution development process.
- Have technical resources available for inspection.
- Have sample documents prepared for assistance (e.g., customer survey, solution form, reports).
- If a central database has been developed to gather the solutions, this should be checked to see if it is functioning correctly.

Teaching/Learning Strategies

1. Teachers discuss with students the importance and value of good customer relations. Students are reminded that it is their moral and ethical imperative to listen closely to customer requirements, and to provide the customer with all the information they need to make informed decisions.
2. Teachers introduce the activity and discuss the context of the activity in relation to the development of consulting/business solutions in the IT industry. This should include a discussion of the latest networking hardware and why different hardware is recommended over others in different situations.

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3. The teacher provides a scenario and walks through a typical procedure to analyse the requirements (Appendix 2.4.1).
 4. A chart will be developed identifying various networking hardware and software with appropriate explanations of how they are used. This information can be collected in a central database (e.g., Filemaker Pro or ColdFusion based website). The use of a major network hardware manufacturer's product line (e.g., Cisco, 3com, HP) is an excellent place to organize this chart. They are typically broken into network component types and indicate clearly where each product should be placed in a total infrastructure.
 5. Once the resource data is collected students are presented with the written customer scenarios in small groups of two or three (Appendix 2.4.2).
 6. Customer needs are documented by the groups and then discussed by the class and the teacher.
 7. Students carefully read through the scenarios and begin the creation of a situation analysis form. The first step is to review what the client requirements are by documenting them again in bullet form.
 8. Students then determine and document what would be required from a networking and hardware perspective to achieve the client outcomes given an ideal scenario. Students must be able to justify why they selected certain components.
 9. Students then determine and document in a similar fashion what aspects of the current scenario are preventing the realization of the desired outcome.
 10. Students review any constraints they should be aware of in developing a solution (e.g., budget).
 11. Students then develop a solution path requiring hardware and implementation strategies for meeting the client's needs.
 12. From these steps the class develops a common form for use in similar tasks. This form details the step-by-step procedures to be taken in evaluating customer needs to configure network solutions. These forms should be developed as work and experience progresses.
 13. Students analyse their collective solution based on: the amount of time required to complete the task; the budget required to implement the solution, and if the solution best meets their clients needs.
 14. This solution is then documented with recommendations, and along with a reason for each recommendation. The format will be in the form of a report to a customer.
 15. Each student prepares an electronic customer report based on the class discussions and hands it in for assessment/evaluation.

Assessment and Evaluation of Student Achievement

Customer reports are assessed on organization, accuracy, completeness, neatness, documentation, quality, and appropriateness of recommendation.

Accommodations

- Students with networking experience should be paired with other classmates requiring assistance to promote a positive accepting environment.
- To accommodate students requiring further assistance, provide pre-developed or partially developed versions of technical solution documents and/or the customer report document.
- As an enrichment activity, students can be presented with more complex scenarios requiring the investigation of new technologies.
- Provide extra visual and hands-on assistance for students with special needs based on recommendations in the exceptional student's IEP.

Resources

Print

- Feibel, Werner. *Encyclopedia of Networking*, 3rd ed. Sybex, 2000. ISBN 0-7821-2255-8
- Feldman, Jonathon. *Sams Teach Yourself Network Troubleshooting in 24 Hours*. Sams, 1998. ISBN 0672314886
- Gregg, Kenneth. *Windows Networking Basics*. Harper Collins Canada, 1998. ISBN 0764532146
- Groth, David and Jim McBee. *Cabling The Complete Guide to Network Wiring*. Sybex, 2000. ISBN 0-7821-2645-6
- Kearns, Dave. *Sams Teach Yourself Windows Networking in 24 Hours*. Sams, 1998. ISBN 0672314754
- Keogh, Jim. *Core MCSE: Networking Essentials*. Prentice-Hall of Canada Ltd. ISBN 0130107336
- Magendanz, Thomas and Radu Popescu-Zeletin. *Intelligent Networks: Basic Technology, Standards & Evolution*. International Thomson Press, 1996. ISBN 1850322937
- MCSE Networking Essentials For Dummies*, Training Kit. IDG Books Worldwide, 1999. ISBN 0764506218
- Minasi, Mark. *The Complete PC Upgrade and Maintenance Guide*. Sybex 2000. ISBN 0-7821-2800-9
- Networking Complete*. Sybex, 2000. ISBN 0-7821-2610-3
- Network+ Certification Study Guide*, Syngress Media, Inc., 1999. ISBN 0-07-211846-6
- Sybex A+ e-Trainer*. Sybex, 2000. ISBN 0-7821-5000-4

Websites

- Novell Network Primer – <http://www.novell.com/info/primer/primer.pdf>
- Intel Resources – <http://www.intel.com/education/k12/resources/index.htm>
- Cisco Certification CCIE – <http://www.cisco.com/warp/public/625/ccie/>
- 3Com's Netprep programme – <http://education.3com.com/Netprep/index.html>
- 3Com Network Interface Support Documents – <http://support.3com.com/infodeli/tools/nic/index.htm>
- D-Link Support Documents – <http://www.dlink.com/tech/resources/>
- Online Ethics Centre for Science and Engineering – <http://www.onlineethics.org>
- Computer Professionals for Social Responsibility – <http://www.cpsr.org/>
- Business Ethics Magazine – <http://www.business-ethics.com/>

Appendix 2.4.1

Example Networking Scenarios

1. Home office with 2 computers, shared printer, and dial-up Internet access
2. Small business of 4 computers located in the same office space. One is acting as the secretary's computer and also the main storage for all the other computers back-up files, which they collect via diskette.
3. Small business of 4 computers each situated in a different geographical location. One is acting as the secretary's computer and also the main storage for all the other computers back-up files, which they collect via mailed diskettes.
4. Medium sized business running 16 computers peer-to-peer. They are experiencing problems with locating data, having to back-up all 16 workstations separately, with security (using Windows 98 individually installed on the computers) and with printing quality and supplies (each person has a low end inkjet printer).

Appendix 2.4.2

Detailed Customer Scenario (Advanced)

Customer Name: *ACME Widgets and Woogles*

Situation

- The ACME Widgets and Woogles Company is trying to develop processes within their company that eliminate waste. Currently they have the following:
- 21 computers – 1 Pentium 3 fileserver running Windows 2000 server, 8 Pentium 3 at 933MHz workstations running Windows 2000 professional, 2 Pentium 2 Celerons at 333MHz running Windows 98, 3 Pentium 133MHz workstations running Windows 95, 7 486s at 75MHz running Windows 3.1.
- The computers are networked using Thinnet (10Base2) but each computer has a multi-connector NIC (includes Thin [10Base2], Thick [10Base5] and Twisted [10BaseT]).

Problems

- Support and Maintenance technician is having difficulty finding parts for any system below a Pentium II.
- All but the latest systems are out of warranty
- The time spent on the various systems increases exponentially with age, i.e., the technician spends over 85% of his time working on the 10 oldest workstations.
- Their ability to implement solutions is based on the requirements of the oldest piece of hardware.
- The design of the cabling causes people to accidentally trip over the thinnet cable in two locations which takes down the network.
- They have recently been rendering large multimedia graphics and incorporating them into presentations. The files are typically several hundred megabytes in size. They have had little success transferring them from one computer to the next except when there is no one else on the network in the early morning.

Appendix 2.4.3

Sample Customer Assessment Form

Step	Description
Client needs assessment	Hardware – Computer Hardware – Networks Software Process Human Resources Other Resources
Ideal scenario	Hardware – Computer Hardware – Networks Software Process Human Resources Other Resources
Issues preventing client needs	Hardware – Computer Hardware – Networks Software Process Human Resources Other Resources
Constraints	Budget Physical Constraints Process Constraints Other Constraints
Recommended resolution	

Activity 5: Network Troubleshooting

Time: 240 minutes

Description

The focus of this culminating activity is to establish troubleshooting procedures based on common networking problems. Students develop troubleshooting procedures to ensure that all aspects of the problem are observed and documented. Students develop strategies for resolving issues to serve customer needs. Students learn to work effectively with others toward shared goals and striving for social justice in light of the common good.

Strand(s) & Learning Expectations

Strand(s): Theory and Foundations, Skills and Processes, Impact and Consequences

Specific Expectations

TF2.02 - explain the importance of keeping records of customer contacts, including the following: customer name, contact information, date, time, description of technical problem, and proposed solution;
SP1.04 - follow prescribed troubleshooting procedures effectively;
SP1.06 - perform basic maintenance on peripherals;
SP1.07 - use utility software to diagnose and correct problems;
SP2.01 - use computer terminology correctly;
SP2.04 - maintain service logs effectively using a database and/or word processor;
SP2.05 - develop installation and service procedures;
IC1.03 - describe job opportunities in local business and industry;
IC1.04 - employ time management skills effectively in the completion of projects;
IC1.05 - effectively communicate the results of projects both orally and in writing.

Overall Expectations

SPV.01 - follow maintenance and repair procedures;
SPV.02 - use utility and application software effectively;
SPV.05 - demonstrate professional customer service practices;
ICV.02 - identify skill sets required for the workplace;
ICV.03 - describe workplace opportunities;
ICV.04 - communicate and work effectively individually and in groups.

Ontario Catholic School Graduate Expectations

CGE3b - create, adapt, and evaluate new ideas in light of the common good;
CGE3f - examine, evaluate, and apply knowledge of interdependent systems (physical, political, ethical, socio-economic, and ecological) for the development of a just and compassionate society;
CGE4f - apply effective communication, decision-making, problem solving, time and resource management skills;
CGE5a - work effectively as an interdependent team member.

Prior Knowledge & Skills

- Hardware familiarization from Unit 1
- An understanding of the basic hardware functions of the operating system
- A clear understanding of the safe handling of computer hardware from Unit 1

Planning Notes

- All hardware/software and/or testing equipment/utilities is prepared and checked in advance.
- Stations are prepared and tested for specific problems. All other aspects of the station must be functional. Provide suggestions starting from very simple (e.g., cable unplugged, printer turned off) to slightly more difficult, but not impossible to ensure this goes smoothly.

Teaching/Learning Strategies

1. The teacher explains the premise of the activity and organization of the stations, including specific difficulties that may be causing problems.
2. The teacher then demonstrates a system with a problem showing what should happen and what in fact does happen.
3. The teacher then develops a diagnosis strategy from stating the required outcome, to documenting the signs and symptoms, to hardware checking, to operating system hardware level checks, to network protocols, to application diagnosis tools, etc.
4. The teacher guides the students in order to prioritize the strategy (e.g., system not printing, don't check the printer driver first, check the hardware [cable, printer, computer], then move on to software, etc.).
5. The process is then documented and the students work in groups of three to four to develop a form to use to diagnose hardware difficulties.
6. Students then present their finding and a common form is developed.
7. Students are placed in pairs and assigned a station to begin with. Students are given a form for each scenario. Each group will have approximately five minutes to document the issue with each of the scenarios before moving to the next station. Repairs will not take place until later; at this point diagnosis is key.
8. Once all stations have been visited, the class will discuss their findings, facilitated by the teacher.
9. Each station situation will be documented centrally and potential first steps discussed for each.
10. One group will be assigned to each station to resolve the issues. Once the resolution is found and implemented, the teacher will be called over to inspect the solution. If the solution has resolved the issue fully, it will be documented centrally.
11. If any groups are having difficulty, other groups can be called upon to assist.
12. The central data will be shared with the students.
13. The teacher facilitates a discussion concerning the need for such a central store in networking/computer hardware careers and how this can impact the viability of any company.
14. The teacher presents potential next steps if students would like to further pursue studies in the area of networking configuration, support and maintenance (e.g., A+, Network +, CCNA certifications).
15. Teachers should role-play the troubleshooting/customer communication process, reinforcing the concept that the most important aspect of troubleshooting is listening, communicating, and gathering information from the customer.

Assessment and Evaluation of Student Achievement

- Formative assessment of each group to check their diagnosis process and documentation ability
- Formative assessment of student progress
- Summative assessment of presentation that combines teacher and student feedback

Accommodations

- Assist with group formation to facilitate a peer tutoring or buddy system to promote an accepting and positive atmosphere and program enhancement or remediation.
- Provide written material for students having difficulty processing auditory information.
- Pre-teach new vocabulary and definitions prior to and during the lesson.
- Ensure understanding of tools used to assess/evaluate.
- Provide print format and clear direction/expectations for presentation of final product.
- As an enrichment activity, students can be presented with the task of developing databases of information or computerizes customer service forms to be used by the class in further work.
- Provide extra visual and hands-on assistance for students with special needs, based on recommendations in the exceptional student's IEP.

Resources

Software

Operating systems (e.g., DOS, Windows 9.x, Windows NT, System 6.x, 7.x, 8.x, Unix, or others)
Ontario Educational Software Services [OESS software tools] (e.g., *Corel WordPerfect*, *Microsoft Works*, *Appleworks*, etc.)

Networking Utilities (e.g., ping, FTP, NetScanTools)

Print

Feldman, Jonathon. *Sams Teach Yourself Network Troubleshooting in 24 Hours*. Sams, 1998.
ISBN 0 672314886

Gregg, Kenneth. *Windows Networking Basics*. Harper Collins Canada, 1998. ISBN 0 764532146

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Networking Complete. Sybex, 2000. ISBN 0-7821-2610-3

Operating System Manuals and reference texts

Sybex A+ e-Trainer. Sybex, 2000. ISBN 0-7821-5000-4

Websites

Novell Network Primer – <http://www.novell.com/catalog/primer/primer.html>

Cisco Certification CCIE – <http://www.cisco.com/warp/public/625/ccie/>

3Com's Netprep programme – <http://education.3com.com/Netprep/index.html>

3Com Network Interface Support Documents – <http://support.3com.com/infodeli/tools/nic/index.htm>

D-Link Support Documents – <http://www.dlink.com/tech/resources/>

Online Ethics Centre for Science and Engineering – <http://www.onlineethics.org>

Computer Professionals for Social Responsibility – <http://www.cpsr.org/>