

COMPUTER SCIENCE FRAMEWORK

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Participants

The following teachers participated in developing the Computer Science Framework.

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A focus group provided suggestions for the framework. Participants included:

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Computer Science Philosophy

The purpose of high school computer science education is for students to develop an understanding and appreciation of the field of computer science and how information systems impact their lives. Students will use a variety of software tools to design, develop, evaluate and update computer programs. Students will be exposed to emerging technologies in order to understand the role of technology in an information-based society.

Beliefs

All students will use computer technology during and after high school. Therefore, all students should develop some understanding and appreciation of technology regardless of whether they become computer professionals or are simply consumers and users of technology.

Students should be provided with challenging experiences in using problem solving strategies.

Students should understand the computer science inherent in various technologies in order to appreciate and effectively use these technologies.

Design and development should reflect current trends in computer science.

Students should be provided opportunities to use a variety of computer hardware, software and techniques.

In order to demonstrate their understanding of computer science, students should be assessed using a variety of methods. These assessments should guide the instructional process.

Differentiation

All students will use computer technology during and after high school. Regardless of their interests, readiness or learner profiles, all students should develop some understanding and appreciation of technology in order to become effective consumers and users of technology. Computer science teachers should use a wide range of instructional strategies and provide students with a variety of experiences, strategies and techniques that can help them develop an understanding of computer science.

Differentiated computer science instruction includes:

- Understanding students' preconceptions about computer science
- Encouraging students to develop their own questions
- Utilizing thinking and problem solving skills
- Providing variety in process, product and content
- Presenting computer science content utilizing a variety of delivery methods
- Providing multi-sensory experiences
- Investigating interdisciplinary connections
- Using a variety of technologies
- Applying computer science to real-life situations
- Engaging students in thoughtful reflection on their learning
- Allowing students to demonstrate their learning in different ways

Computer science teachers will make conscious use of differentiation strategies by continuing to pursue and apply information related to readiness, interest, learning profiles, and cultural and ethnic differences.


References

Heacox, Diane. (2002). *Differentiating Instruction in the Regular Classroom: How to Reach and Teach All Learners, Grades 3-12*. Minneapolis, MN: Free Spirit Publishing.

Tomlinson, Carol Ann. (1999). *The Differentiated Classroom: Responding to the Needs of All Learners*. Alexandria, VA: Association for Supervision and Curriculum Development.

Millard Essential Learner Outcomes

- **CITIZENSHIP** • **CONSUMER ECONOMICS** • **HUMAN RELATIONS** • **LITERACY AND COMMUNICATION**
 • **MATHEMATICS** • **READINESS FOR WORK** • **READINESS FOR LIFE-LONG LEARNING** • **SCIENCE**
 • **SOCIAL STUDIES** • **TECHNOLOGY** • **FINE AND PERFORMING ARTS** • **WELLNESS**

ACADEMIC SKILLS AND APPLICATIONS	LIFE SKILLS AND PERFORMANCES
<p>Students will demonstrate proficiency on these twelve indicators by meeting established standards on district-wide assessments. This proficiency, along with the successful completion of 225 credits for the class of 2004 and beyond, is used for diploma granting or denial. Students in the Millard Public Schools will:</p> <p>LITERACY AND COMMUNICATION</p> <ol style="list-style-type: none"> 1. Demonstrates competencies in reading to understand and evaluate a variety of texts. 2. Demonstrate competencies in writing in a variety of modes. <p>MATHEMATICS</p> <ol style="list-style-type: none"> 4. Represent numbers and relationships between numbers, compute fluently, and make reasonable estimates. 5. Understand and use attributes of geometric figures and systems of measurement. 6. Demonstrate knowledge of and use coordinate systems and algebraic concepts. 7. Select, organize, display and analyze data. 8. Apply appropriate mathematical strategies to solve problems. <p>SCIENCE</p> <ol style="list-style-type: none"> 9. Use scientific processes to understand the unifying concepts of the natural world. 10. Demonstrates understanding of life, physical, earth and space sciences. <p>SOCIAL STUDIES</p> <ol style="list-style-type: none"> 11. Demonstrates understanding of structure, operations and relationships between local, state, national and international governments 12. Demonstrates practical knowledge of history, economics and geography 13. Understand global independence. <hr style="border-top: 1px dashed black;"/> <p>Course outcomes and assessments will determine program and building accountability in the areas of clarity (what is to be taught) competence (what is to be learned), consistency (among buildings), continuity (articulation) and communication (among teachers and with parents). The following indicators are not used for diploma-granting or denial.</p> <p>LITERACY AND COMMUNICATION</p> <ol style="list-style-type: none"> 3. Demonstrates appropriate speaking and listening skills for a variety of settings. <p>CONSUMER ECONOMICS</p> <ul style="list-style-type: none"> • Demonstrates skills in managing money. • Makes sound financial choices by using appropriate resources. <p>HUMAN RELATIONS</p> <ul style="list-style-type: none"> • Understands ethnic and cultural differences. • Understands human differences. <p>TECHNOLOGY</p> <ul style="list-style-type: none"> • Obtains information electronically and organizes it successfully • Conveys information using technology • Uses a variety of technological resources to solve problems. <p>FINE AND PERFORMING ARTS</p> <ul style="list-style-type: none"> • Experiences and evaluates a variety of music, art, or drama. <p>WELLNESS</p> <ul style="list-style-type: none"> • Understands human growth and development • Identifies the values of good nutrition and physical activity • Evaluates the impact of addictive substances and behaviors 	<p>Within the school setting, students in the Millard Public Schools will:</p> <p>READINESS FOR WORK</p> <ul style="list-style-type: none"> • Demonstrate the ability to manage time • Demonstrate the ability to follow directions • Solve problems by processing available information pertinent to a given situation, making decisions as appropriate • Develop ability to work with others to accomplish tasks/goals • Demonstrate essential knowledge of good work habits • Demonstrate responsibility <p>READINESS FOR LIFE-LONG LEARNING</p> <ul style="list-style-type: none"> • Demonstrate ability to set and pursue short term and long term goals • Obtain, organize and evaluate information successfully • Develop the attributes of: <ul style="list-style-type: none"> integrity, self-discipline, positive attitude perseverance <p>CITIZENSHIP</p> <ul style="list-style-type: none"> • Participate in community and/or school organization • Acknowledge diversity of others • Respect the rights of others • Treat others in a considerate and non-demeaning manner <p style="margin-top: 20px;">Revised: Strategic Planning December 5, 1996 T-Chart Approved: Millard Board of Education January 13, 1997 Rule Adopted: May 3, 1999 Revised: June 18, 2001; July 21, 2003</p> <div style="text-align: right; margin-top: 20px;">  </div>

NETS for Students

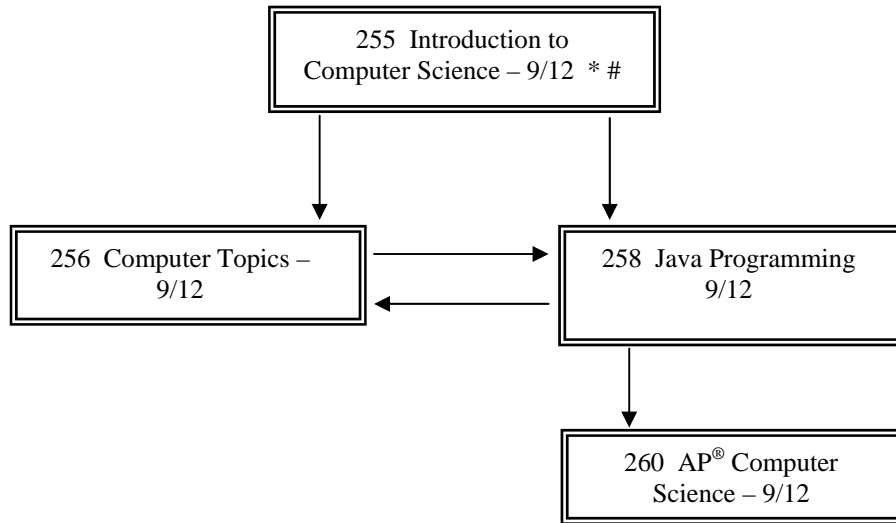
Technology Foundation Standards for All Students

The technology foundation standards for students are divided into six broad categories. Standards within each category are to be introduced, reinforced, and mastered by students. These categories provide a framework for linking performance indicators within the Profiles for Technology Literate Students to the standards. Teachers can use these standards and profiles as guidelines for planning technology-based activities in which students achieve success in learning, communication, and life skills.

Technology Foundation Standards for Students

1. Basic operations and concepts
 - Students demonstrate a sound understanding of the nature and operation of technology systems.
 - Students are proficient in the use of technology.
2. Social, ethical, and human issues
 - Students understand the ethical, cultural, and societal issues related to technology.
 - Students practice responsible use of technology systems, information, and software. Students develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
3. Technology productivity tools
 - Students use technology tools to enhance learning, increase productivity, and promote creativity.
 - Students use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
4. Technology communications tools
 - Students use telecommunications to collaborate, publish, and interact with peers, experts, and other audiences.
 - Students use a variety of media and formats to communicate information and ideas effectively to multiple audiences.
5. Technology research tools
 - Students use technology to locate, evaluate, and collect information from a variety of sources.
 - Students use technology tools to process data and report results.
 - Students evaluate and select new information resources and technological innovations based on the appropriateness for specific tasks.
6. Technology problem-solving and decision-making tools
 - Students use technology resources for solving problems and making informed decisions.
 - Students employ technology in the development of strategies for solving problems in the real world.

Recommendations for Sequence of Computer Science Courses



* Students must complete Geometry before taking Introduction to Computer Science.

Introduction to Computer Science satisfies Millard's Technology Education graduation requirement.

Students who complete Introduction to Computer Science and Java Programming are eligible to apply for the STARS Internship, part of Millard South High School's Information Technology Mini-Magnet.

INTRODUCTION TO COMPUTER SCIENCE

Introduction to Computer Science

9/12

S

5 Credits

Course Description: Introduction to Computer Science, the first of four computer science courses offered in Millard, provides an exposure to computer technology. Students will design and write object-oriented computer programs, use databases and create Web pages. Visual Basic.net is the primary language used in this course. In addition, students will use Alice and Dreamweaver. Completion of this course is a prerequisite for other computer science courses and satisfies Millard's technology education graduation requirement.

Prerequisite: Geometry

Outcome 1

Students will apply their knowledge of computing devices and the Internet by developing Web documents.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Demonstrate a sound understanding of the nature and operation of technology systems.
- Understand the ethical, cultural, and societal issues related to technology.
- Use technology tools to enhance learning, increase productivity, and promote creativity.

Objectives

Students will:

- Explain the importance of computers in their daily lives.
- Demonstrate knowledge of ethical behavior.
 - Observe copyright laws
 - Cite sources
 - Be a good network citizen
 - Avoid software piracy
- Demonstrate some knowledge of the history of computing devices, Internet and software.
- Demonstrate knowledge of a computer network.
 - Transmission of files
 - Vocabulary
- Create a web document.

Assessment

Design and implement a Web document.

Outcome 2

Students will use basic structures and programming design patterns to implement a solution to an algorithmic problem.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Practice responsible use of technology systems, information, and software.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Demonstrate correct use of the vocabulary and acronyms of the current computer language.
- Understand and use correct program design processes.
 - Flow charts
 - Hierarchical charts
 - Pseudocode
 - Walk-throughs
- Demonstrate correct use of programming constructs under sequential, loop, selection and module structures.
- Understand and use number functions appropriately.
- Demonstrate recursive thinking.

Assessment

Design and implement a computer program using all four structures: sequential, loop, selection and module.

Outcome 3

Students will apply their knowledge of databases to design and implement a solution to an algorithmic problem.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Use technology tools to process data and report results.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Create and use databases in a program.
- Sort a database using various techniques.
- Manipulate a database.

Assessment

Design and implement a database using a sorting algorithm.

Outcome 4

Students will solve problems using object-oriented programming principles.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Use technology tools to process data and report results.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Experience object-oriented programming through a step-by-step-tutorial.
- Create and use an object-oriented program.

Primary Resources

An Introduction to Programming Using Visual Basic.net (2005, Prentice Hall)

Visual Studio.net software (includes Visual Basic.net)

Studio MX software (includes Dreamweaver)

Alice software

The Internet

JAVA PROGRAMMING

Java Programming

9/12

S

5 Credits

Course Description: This course is a prerequisite to Advanced Placement[®] Computer Science and is designed for college-bound students who will take one or more semesters of computer programming in college. Students will solve problems using the Java programming language.

Prerequisite: Introduction to Computer Science

Outcome 1

Students will use basic structures and programming design patterns to implement a solution to an algorithmic problem.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Understand the ethical, cultural, and societal issues related to technology.
- Practice responsible use of technology systems, information, and software.
- Develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Demonstrate knowledge of ethical behavior.
 - Observe copyright laws
 - Cite sources
 - Be a good network citizen
 - Avoid software piracy
- Understand and use correct program design processes.
 - Flow charts
 - Hierarchical charts
 - Pseudocode
 - Walk-throughs
- Understand and use programming constructs under sequential, loop, selection and methods structures.

- Demonstrate correct use of the vocabulary and acronyms of the current computer language.
 - Demonstrate how analysis, design and coding can be done from the object-oriented view.
 - Demonstrate recursive thinking. *
- * Optional

Assessment

Design and implement a computer program using all four structures: sequential, loop, selection and methods.

Outcome 2

Students will use basic data structures to design and implement a solution to an algorithmic problem.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Use technology tools to process data and report results.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Create and use a one-dimensional array in a program.
 - Create text files.
 - Use text files in a program.
 - Create and use classes in a program.
 - Create and use multi-dimensional arrays in a program. *
- * Optional

Assessment

Design and implement a computer program using data structures.

Primary Resources

Programming and Problem Solving with Java (2003), Jones and Bartlett
 Java development software and run time environment
 The Internet

COMPUTER TOPICS

Computer Topics

9/12

S

5 Credits

Course Description: In Computer Topics, students explore a variety of concepts: computer numbering systems, computer logic, structure of the central processing unit and microprocessor, multi-media, animation, fractal geometry, robotics and programming languages. Students will study areas of interest in depth.

Prerequisite: Introduction to Computer Science

Outcome 1

Students will investigate a variety programming concepts in depth, and design and implement plans to complete projects or solve problems identified by the students.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Convey information using technology.
- Use a variety of technological resources to solve problems.

Life Skills ELOs

- Demonstrate the ability to follow directions.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Understand the ethical, cultural, and societal issues related to technology.
- Use productivity tools to collaborate in constructing technology-enhanced models, prepare publications, and produce other creative works.
- Use technology tools to process data and report results.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Investigate the architecture and operation of a central processing unit.
- Investigate animation software.
- Write a Visual Basic, Java or Scheme graphics program.
- Write a program for a graphing calculator.
- Convert between different numbering systems.
- Solve computer logic problems using Boolean algebra, digital electronics or graph theory.
- Create a presentation using presentation software. *
- Use robotics programming to solve a problem. *
- Write a song and sound using a programming language. *
- Create fractals and chaotic situations. *
- Develop a web browser. *

- Investigate the designing of programs. *
 - Investigate other topics or complete other projects chosen by the student or suggested by the teacher. *
- * Because of the exploratory nature of this course, students are not expected to work on each of these objectives. With advice and approval from the teacher, students choose from these objectives.

Assessment

Portfolio of projects

Primary Resources

Because of the exploratory nature of this class, a variety of resources will be utilized, including:

Bryce (scenery graphics)
Poser (live characters animation)
DrScheme
Visual Studio.net
True BASIC™ (sound manipulation)
Java
Lego Mindstorms (robotics)
Super Goo (morphing)
Dabbler (cartoon maker)
Studio MX
Carrara (3-D animation)
Maya
Alice (virtual reality)
Microsoft Office
The Internet

ADVANCED PLACEMENT[®] COMPUTER SCIENCE

Advanced Placement[®] Computer Science

9/12

Y

10 Credits

Course Description: Advanced Placement[®] Computer Science, a continuation of Java programming, is designed for college-bound students. Students will solve problems using Java and a variety of object-oriented programming techniques. After completion of the course, students will be prepared to take the College Board Advanced Placement[®] examination.

Prerequisite: Java Programming

Outcome 1

Students will use object-oriented principles to design software to solve a given problem.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Obtain information electronically and organize it successfully.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Demonstrate a sound understanding of the nature and operation of technology systems.
- Are proficient in the use of technology.
- Understand the ethical, cultural, and societal issues related to technology.
- Use technology tools to process data and report results.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Specify the purpose and goals for a problem.
- Apply data abstraction and encapsulation.
- Decompose a problem into classes; define relationships and responsibilities of those classes.
- Understand and implement a given class hierarchy.
- Identify reusable components from existing code using classes and class libraries.
- Design and implement a set of interacting classes.
- Design an interface.
- Choose appropriate advanced data structures and algorithms.
- Apply functional decomposition.
- Extend a given class using inheritance.

Assessment

Performance: Using data structures and algorithms, students will design, implement, analyze and evaluate a program to solve a given problem.

Portfolio: Throughout the course, students will create a portfolio of their work.

Outcome 2

Students will implement an object-oriented solution for a given problem.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Obtain information electronically and organize it successfully.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Are proficient in the use of technology.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Use a variety of implementation techniques (object-oriented development, encapsulation and information hiding, and procedural abstraction).
- Use a variety of programming constructs (primitive types vs. objects, declaration of Java modifiers, console output, control structures).
- Use AP Java subset.

Assessment

Performance: Using data structures and algorithms, students will design, implement, analyze and evaluate a program to solve a given problem.

Portfolio: Throughout the course, students will create a portfolio of their work.

Students will answer pre-released AP[®] exam free response question(s) or their equivalent.

Outcome 3

Students will analyze and evaluate the effectiveness of the program they have developed.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Obtain information electronically and organize it successfully.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Demonstrate a sound understanding of the nature and operation of technology systems.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Test, debug, modify and extend existing code.
- Understand error handling.
- Reason about programs using pre- and post-conditions, assertions and invariants.
- Analyze algorithms using running times, Big-Oh notation and time and space analysis.
- Understand and know how to use numerical representations and their limits.

Assessment

Performance: Using data structures and algorithms, students will design, implement, analyze and evaluate a program to solve a given problem.

Portfolio: Throughout the course, students will create a portfolio of their work.

Outcome 4

Students will use data structures and algorithms correctly.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Obtain information electronically and organize it successfully.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Demonstrate a sound understanding of the nature and operation of technology systems.
- Use technology tools to process data and report results.
- Use technology resources for solving problems and making informed decisions.
- Employ technology in the development of strategies for solving problems in the real world.

Objectives

Students will:

- Incorporate a variety of data structures into programs.
- Incorporate a variety of data structure operations into programs.
- Incorporate a variety of data structure searches into programs.
- Incorporate a variety of data structure sorts into programs.

Assessment

Performance: Using data structures and algorithms, students will design, implement, analyze and evaluate a program to solve a given problem.

Portfolio: Throughout the course, students will create a portfolio of their work.

Outcome 5

Students will understand computing in context.

Academic ELOs

- Demonstrate competencies in writing in a variety of modes.
- Apply appropriate mathematical strategies to solve problems.

Life Skills ELOs

- Obtain information electronically and organize it successfully.
- Convey information using technology.
- Use a variety of technological resources to solve problems.
- Solve problems by processing available information pertinent to a given situation, making decisions as appropriate.
- Obtain, organize and evaluate information successfully.

Technology Foundation Standards for Students

- Demonstrate a sound understanding of the nature and operation of technology systems.
- Are proficient in the use of technology.
- Practice responsible use of technology systems, information, and software.
- Develop positive attitudes toward technology uses that support lifelong learning, collaboration, personal pursuits, and productivity.

Objectives

Students will:

- Explain and use major hardware components (e.g., memory, processors, peripherals).
- Explain and use system software (e.g., translators/compiler, virtual machines, operating systems).
- Compare and contrast types of single-user and network systems.
- Use computer systems responsibly.

Assessment

Because the AP[®] course outline recommends these objectives be integrated throughout the course, they will be included in the rubrics for the four other course assessments.

Primary Resources

Programming and Problem Solving with Java (2003), Jones and Bartlett

Object-Oriented Data Structures Using Java (2002), Jones and Bartlett

Java development software and run time environment

The Internet