GEORGIA | PEACH STATE PATHWAYS

Career, Technical, & Agricultural Education

BUSINESS & COMPUTER SCIENCE

PATHWAY: Computing

COURSE: Intermediate Programming

UNIT: 5-Physical Constraints of Computing and Limits of Computing

INTRODUCTION

Annotation:

Grade(s):

X	9th
X	10th
X	11th
X	12th

Time: 20 hours (4 weeks)

Author: Jason Naile

Additional Author(s):

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation.

FOCUS STANDARDS

GPS Focus Standards:

BCS-IP-11 Students will identify the physical constraints on computing.

a. Investigate miniaturization and its relationship to sub-atomic concerns.

b. Identify the thermodynamic limits on energy dissipation.

c. Identify the speed-of-light limitations on computing and discuss its implications.

d. Explain and give examples of parallel processing.

BCS-IP-12 Students will examine the limits to computing based on complexity and computability.

a. Define complexity theory.

b. Compare polynomial time versus exponential time.

c. Define non-deterministic and intractable.

d. Discuss the importance of computational time in relationship to solvable problems.

e. Explain the Turing Machine and its relationship to the halting problem.

GPS Academic Standards:

ELA12W3 The student uses research and technology to support writing.

ELA12LSV1 The student participates in student-to-teacher, student-to-student, and group verbal interactions.

National Standards:

UNDERSTANDINGS & GOALS

Enduring Understandings:

- As a result of this unit, students should be able to understand, discuss, and explain the limits of computing based on physical constraints, complexity, and computability. Students also will be able to identify and explain technological advances that can possibly overcome these constraints.

Essential Questions:

- What are physical constraints on computing?
- How are miniaturization and sub-atomic concerns related?
- What are some examples of parallel processing?
- What are the implications of speed-of-light limitations on computing?
- What are some limits of computing based on complexity and computability?

- What is the difference between polynomial and exponential time?
- What is the importance of computational time in relationship to problems?
- What is the Turing machine?
- How is the Turing machine related to the halting problem?

Knowledge from this Unit:

Skills from this Unit:

- Students will use technological resources for research and writing purposes.

ASSESSMENT(S)

Assessment Method Type: Select one or more of the following. Please consider the type(s) of differentiated instruction you will be using in the classroom.

_____ Pre-test
_____ Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
_____ Group project
_____ Individual project
_____ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
_____ Subjective assessment/Informal observations
__ Essay tests
__ Observe students working with partners
__ Observe students role playing
X Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
_____ Dialogue and Discussion
__ Student/teacher conferences
__ Partner and small group discussions
__ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
_____ Constructed Responses
__ Chart good reading/writing/listening/speaking habits
__ Application of skills to real-life situations/scenarios
_____ Post-test

Assessment(s) Title: **Paper Evaluation by Peers**

Assessment(s) Description/Directions:

Prior to turning in the final paper of the unit performance task, students will exchange papers with at least three classmates. Classmates will use the rubric provided to evaluate the paper and offer suggestions for improvement. This will play an important role in the editing process.

Attachments for Assessment(s): **Project Specifications and Rubric**
(Complete description of the paper at the conclusion of the unit along with a grading rubric.)

Web Resource Title: Miniaturization Article

Web Resource Description: An article on how miniaturization helps to push the limits of computing. This can be used as a resource for the teacher or students.

Web Resource: http://www.sciencedaily.com/releases/2008/01/080112083626.htm

LEARNING EXPERIENCES

Instructional planning: Include lessons, activities and other learning experiences in this section with a brief description of the activities to ensure student acquisition of the knowledge and skills addressed in the standards. Complete the sequence of instruction for each lesson/task in the unit.

Sequence of Instruction

1. **Identify the Standards. Standards should be posted in the classroom for each lesson.**

   BCS-IP-11 Students will identify the physical constraints on computing.

   BCS-IP-12 Students will examine the limits to computing based on complexity and computability.

2. **Review Essential Questions.**

   - What are physical constraints on computing?
   - How are miniaturization and sub-atomic concerns related?
   - What are some examples of parallel processing?
   - What are the implications of speed-of-light limitations on computing?
   - What are some limits of computing based on complexity and computability?
   - What is the difference between polynomial and exponential time?
   - What is the importance of computational time in relationship to problems?
   - What is the Turing machine?

- How is the Turing machine related to the halting problem?

3. Identify and review the unit vocabulary.

4. Assessment Activity.

Sequence of Instruction and Learning:

Week 1: Limits of Computing based on Physical Constraints

Week 2: Limits of Computing based on Complexity and Computability

Week 3: Technological Advances

Week 4: Unit Performance Task

Technology Connection/Integration

Technology will be used by teachers to introduce topics, show videos, and lead discussions. Students will use technology for research and as a productivity tool.

Attachments for Learning Experiences: Please list.

Notes & Reflections:

- A good idea would be for students to include a new limit on computing, other than those introduced in class, in their paper. Additionally, have the students identify a technological advance that can overcome the limit that has been researched.

CULMINATING PERFORMANCE TASK (Optional)

Culminating Unit Performance Task Title: **Physical Limits of Computing Paper**

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Students will identify four limits of computing based on physical constraints, complexity and computability. This paper will identify and explain these limits and provide ways technology can overcome them. Research will be used in support of their statements.

Attachments for Culminating Performance Task:

Rubric for Performance Task:

Physical Constraints and Limits of Computing

Directions: Over the last few weeks we have spent time discussing the many limits of computing. Identify and explain four of these constraints. Then, list and explain possible technological advances that can potentially overcome these constraints. Support your statements with research.

90-100 (Excellent) Four constraints are identified and explained very clearly. Technological advances that can be used to overcome these constraints are identified and explained very clearly. Statements are supported with reliable research. Very few grammatical errors are present.	**80-89 (Acceptable)** Four constraints are identified and explained clearly. Technological advances that can be used to overcome these constraints are identified and explained clearly. Statements are supported with research. Few grammatical errors are present.
75-79 (Marginal) Four constraints are identified and explained somewhat clearly. Technological advances that can be used to overcome these constraints are identified and explained somewhat clearly. Statements are supported with research, although some sources may or may not be reliable. Some grammatical errors are present.	**70-74(Needs Improvement)** Four constraints are identified but not explained. Technological advances that can be used to overcome these constraints are identified but not explained somewhat clearly. Statements are supported with research, although most sources may or may not be reliable. Many grammatical errors are present.
<70 (Resubmission) No constraints are identified. No technological advances that can overcome these advances are listed either. Statements are not supported with research. Many grammatical errors are present in the paper.	

Comments:

UNIT RESOURCES

Web Resources:

Attachment(s):

Materials & Equipment:

Computer

Projector

Microsoft PowerPoint (or other presentation software)

Microsoft Word (or other word processing software)

Internet/Network connection

Network Storage space

What 21st Century Technology was used in this unit:

X	Slide Show Software		Graphing Software		Audio File(s)
	Interactive Whiteboard		Calculator		Graphic Organizer
	Student Response System		Desktop Publishing	X	Image File(s)
	Web Design Software		Blog		Video
	Animation Software		Wiki		Electronic Game or Puzzle Maker
	Email	X	Website		