



Teaching Guide

For

Upgrading Computer Lab

Illinois Transportation, Distribution and Logistics Math and Science Project

2009

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Scenario Focus

Overview of Module

This module was created in conjunction with the New Athens Unit School District 60 School Board and Superintendent. It was to assist in conducting a feasibility study of upgrading the existing computer lab to a wireless computer lab with state of the art workstation facilities.

Primary Career Pathway: Information Technology

Occupation/Job Titles Related to this Scenario:

Information Technology Engineer, Computer Engineer, Network Technician.

Recommended Teaching Subject Areas: Computer Science, Mathematics and Agricultural Communications.

Scenario Problem Statement and Performance Elements

New Athens High School Board has asked the Superintendent to explore the feasibility of upgrading the existing computer lab to a wireless computer lab with state of the art workstation facilities. The Superintendent has approached the Math Department to take the lead and our Agriculture Department to provide support for this initiative. The feasibility study should include scale drawing and model and a list of materials and services needed with costs. This is to be presented to the administration and the School Board.

Cluster Knowledge and Skills and Performance Elements

- Develop requirements to do a cost analysis for an Information Technology (IT) project
- To find business contacts and Internet sources for pricing information to complete IT projects
- To understand the complete development process for collecting and presentation of a business plan and feasibility study
- To find sources to perform specialized tasks for environmental, structural and IT upgrades

Illinois Learning Standards:

Math - Stage II

- 6B. Solve problems using number facts, operations and their properties.
- 6C. Compute and estimate using mental math, paper and pencil methods, calculators and computers.
- 7C. Use appropriate technology, instruments, and formulas to solve problems, interpret results, and communicate findings.
- 8B. Can interpret and describe numerical relationships using tables and graphs.
- 9A. Can demonstrate and apply geometric concepts involving lines, planes and space.
- 10A. Can organize, describe and make predictions from existing data.
- 10B. Can gather and analyze data, and communicate findings.

Science - Stage II

- 11A. Know and apply the concepts, principles and process of scientific inquiry.
- 11B. Know and apply concepts, principles and process of technological design.
- 13B. Know and apply concepts that describe the interaction between science, technology and society.

What we want students to know.	What we want students to be able to do.
<ul style="list-style-type: none">• How to collect requirements for an IT project• Understand how environmental issues and social engineering issues inter-relate• Understand the concept for developing an IT project	<ul style="list-style-type: none">• To be able to search out sources for equipment to complete and IT project• To be able to search out sources to provide installation support necessary to complete the project• To be to locate sources for costing of material and labor for the completion of a project• To be able to provide a professional presentation of a business plan and feasibility study of all aspect of the IT project.

Objectives:

- Learn about the many phases and efforts of the requirement collection process
- Learn how to develop sources to provide costing for equipment and installation involved in an IT process
- Be able to differentiate between costing and evaluate the best dollar value available

- Learn how to develop a detailed business plan that includes all foreseeable costs
- Learn how to develop a professional presentation that will not only impress your IT customer but also explain all stages, efforts and costs of the project
- Learn how to be a project manager for an IT project

Measurement Criteria for an acceptable solution:

1. All aspects (computers, furniture and environmental issues) of the project are addressed. Computers must include CPU (processor speed, DRAM and storage/hard drive size); monitor (size and capabilities); and network connectivity (wired or wireless, physical media and speed of connection).
2. A scale drawing and model of the lab.
3. A list of materials and services required to complete a complex IT project was developed.
4. A professional business presentation is developed that contains visual aides.
5. Cost of the project is included in the presentation.
6. Each member of each team can answer questions about the phases of the business plan or is familiar enough with the sources to find the answer to any question.
7. All calculations are backed up by the appropriate pricing document.

Teacher Notes:

Students will begin preparation for the Problem Based Learning module with a presentation about all the aspects to consider for any IT project. From this presentation students will develop and collect requirements for complex IT projects. The project should be divided logically so that students can be segregated into different teams to address different aspects of the project (environmental, structural, and automation). The teacher will need to continually oversee the project to ensure students have the resources available to complete their tasks.

We chose to divide the lessons so that each class had a part. However, one class could have done all the lessons.

Time Required to Complete the Problem:

Math Seminar Class - 11 class periods for Lessons 1, 2, 3, and 7.

Pre-Calculus Class - 8 class periods for Lessons 5 and 6
Ag Communications Class - 3 class periods for Lesson 4

Support Materials and Resources Necessary for Completion of the Scenario:

Computers with access to the Internet

Access to Professional Electricians

Access to Professional Network Engineers

Lesson 1		Introduction: Choosing a Home Computer
Time Estimate: 2 - 50 minute class periods		
Objectives		
<ol style="list-style-type: none"> 1. Students will understand the necessary characteristics of a home computer. 2. Students will be able to choose a computer based on home needs. 3. Students will be able make a comparison of price to attributes. 		
Materials & Resources		
<ul style="list-style-type: none"> • Handout 1, Choosing a Home Computer • Handout 2, Memo from the Superintendent • Computer with Access to Internet • Websites: <ul style="list-style-type: none"> http://www.dell.com/ http://www.hp.com/ http://www.gateway.com/ 		
Agenda		
Step	Minutes	Activity
1	45	<ul style="list-style-type: none"> -Distribute copies of Handout 1, Choosing a Home Computer. -Discuss the different attributes of the of home computers -Discuss laptops versus desktops -Discuss uses of computer; Word, Excel, PowerPoint, Games, Pictures, Videos, etc. -Discuss the differences in Screen sizes, CPU speeds, Memory, and Storage capacity. -Groups discuss the uses of their home computers (<i>i.e. games, music, movies, homework, etc.</i>) -Groups discuss and list what they know and do not know about computer characteristics. -Groups will go to the computer lab and use the resources to familiarize themselves with different characteristics of laptop and desktop computers. -Groups will collect information about laptops and desktops and information about screen sizes, CPU speeds, Memory and Storage Capacity.

		-Groups will discuss with in the group about their understanding of each of the possible characteristics for their home computer.
2	45	-Revisit Handout 1 and review home computer characteristics. -Return to computer lab, use the resources given and build a home computer price list and a component list staying within the fiscal guidelines. -Present the price and component list and the group's choice of and a justification for a choice of home computer.
3	10	-Distribute Handout 2, Memo from the Superintendent. -Discuss any questions students have about the problem. -Have them make a list of things they will need to know to complete the project and put these on the board or a handout for future reference.

Choosing a Home Computer

1. The problem is you need to choose a new home computer. You have a budget of \$1000.
2. The things to consider are as follows:
 - a. What is your primary use; word processing, spreadsheet, power point, internet, videos, games, etc?
 - b. What type of Screen size and type, CPU speed and type, Memory size and type, Storage Capacity?
 - c. Price for each additional component.
3. Assumptions:
 - a. Students will only consider windows based computers.
 - b. Students will only consider Dell, HP and Gateway computers as listed in the resources.
4. Grading:
 - a. Each student group will provide a components and price list of a home PC from one of the Internet resources.
 - b. Each student group will do a short 5-7 minute presentation on their PC capabilities, components, and why they made the choice they did.
 - c. Each student group will have stayed within fiscal constraint.

MEMO

FROM: Kyle Freeman, Supt.
TO: Math Class
RE: Upgrading Computer Lab

New Athens High School Board has asked me to explore the feasibility of upgrading the existing computer lab to a wireless computer lab with state of the art workstation facilities. I need your help in taking the lead with support from the calculus class and the Ag communications class. I need you to do a feasibility study which includes the equipment needed with specifications; the cost of this equipment; a scale drawing and model and a list of materials and services needed. This is to be presented to the administration and the School Board.

I hope you have this work completed within the next couple of weeks.

Lesson 2		Wireless Computer, Equipment and Furniture
Time Estimate: 3 - 50 min. class periods		
Objectives		
<ol style="list-style-type: none"> 1. Students will understand the requirements of Wireless Local Area Networks. 2. Students will be able to compile a list of equipment to include power ratings and furniture for the completion of a wireless LAN project. 		
Materials & Resources		
<ul style="list-style-type: none"> • Computer with Access to Internet and Spreadsheet Software • Websites: http://webjunction.org/do/DisplayContent?id=1275&source=rss http://www.sbcisd.net/Departments/technology/lab_setup.html http://www.education-world.com/a_tech/tech025.shtml 		
Agenda		
<i>Step</i>	<i>Minutes</i>	<i>Activity</i>
1	25	<ul style="list-style-type: none"> -Introduce the basic requirements of Wireless Local Area Network. -Discuss the amount of space needed for a computer work station. -Talk about resources to find information about power requirements for routers, switches and computer workstations and other peripheral devices.
2	22	<ul style="list-style-type: none"> -Go to the computer lab and use search engines to find the sources for information. -Have students collect resources and be prepared to discuss what each resource provides for the next class period.
3	15	<ul style="list-style-type: none"> -Review resource lists from the last class and have student's focus group efforts on specific resources.
4	32	<ul style="list-style-type: none"> -Go to the computer lab and finalize the list of power requirements, furniture type and costs into a list of material to be purchased.
5	20	<ul style="list-style-type: none"> -Review the group lists and critique for any possible missing items.

6	27	-Return to computer lab and finalize lists in spreadsheet form to give to Pre-Calculus class for scale drawing representation and to Ag Communications class for total power requirements calculations.

Lesson 3		Energy Inputs/Outputs
Time Estimate: 3 50-55 minute class periods		
Objectives		
<ol style="list-style-type: none"> 1. Students will be able to define and understand basic electrical terms. 2. Students will be able to use electrical formulas to determine probable costs and use. 3. Students will be able to figure approximate cost of the high school computer lab using inputs/outputs of machines. 		
Materials & Resources		
<ul style="list-style-type: none"> • Handout 3, Electrical Terms and Safety • Handout 4, Finding Volts, Watts and Amps • Handout 5, Cost of Electricity • Spreadsheet from Lesson 2 for power requirements • Websites: www.mycaert.com 		
Agenda		
<i>Step</i>	<i>Minutes</i>	<i>Activity</i>
1	25	<ul style="list-style-type: none"> -Distribute copies of Handout 3, Electrical Terms and Safety. -Discuss electrical terms and relevance to use in homes, schools and businesses. -Discuss where electricity comes from and total output/input. -Discuss needs of electricity, amounts of use per room or building.
2	25	<ul style="list-style-type: none"> -In groups, have students discuss the different needed items that are daily used with electricity. -Groups are to discuss what knowledge they already know about basic electricity. -Have groups investigate items in the classroom that use electricity
3	20	-Distribute Handout 4, Finding Volts, Amps and Watts

		<ul style="list-style-type: none"> -Go over formulas for finding volts, amps and watts. -Have students complete Handout 5 in groups using given formulas.
4	30	<ul style="list-style-type: none"> -Give students Spreadsheet information obtained from Lesson 2. -Have students compute the volts, amps and watts used in the computer lab per computer station. - Have students compute the volts, amps and watts used total in the computer lab per hour. -Have students compute the volts, amps and watts used total in the computer lab per day, week, month, school year
4	15	<ul style="list-style-type: none"> - Go over answers to Handouts 3 and 4 and computations of volts, amps and watts used. -Distribute Handout 5, Calculating the cost of Electricity. -Review formulas with the class and answer any questions. -Have students complete Handout 5 and go over answers. -Given kilowatts and electricity costs per hour (as given from Egyptian Electric) determine a mock cost to use computers in the lab.
5	45	<ul style="list-style-type: none"> -Using information provided from Lesson 2, determine total cost of electricity in the computer lab.

Electrical Terms and Electrical Safety

Instructions: Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|--------------------|--|
| a. resistance | f. alternating current |
| b. insulators | g. circuit |
| c. voltage | h. GFCI (ground-fault circuit interrupter) |
| d. direct current | i. amperage |
| e. circuit breaker | j. service panel |

- _____ 1. The amount of electrical current flowing past a point in a circuit.
- _____ 2. The tendency of a substance to resist the flow of electrons or current.
- _____ 3. The flow of electric current in one, constant direction.
- _____ 4. The device used to house the circuit breakers or fuses, which in turn distributes the power to individual circuits.
- _____ 5. Materials that have high resistance to the flow of electrical current. They are used to confine the flow of electricity to desired paths.
- _____ 6. A heat-sensitive switch that automatically trips when the electricity demand is too high.
- _____ 7. The pressure in a circuit that causes the electrons or current to flow.
- _____ 8. The path of electric current from its source to the device and back to the source again.
- _____ 9. The flow of current that reverses directions 120 times per second.
- _____ 10. A device used to protect people when electricity is being used in damp areas such as kitchens and bathrooms.

Instructions. Provide the word or words to complete the following statements.

1. Electrical power is measured in _____.
2. In some large applications, multiple transformers can be used to provide electricity so that there are equally spaced peak voltages. This is referred to as _____ power.
3. Materials that do a good job in carrying electricity with little resistance are called _____.
4. A condition that exists when too much electricity is flowing and the rated amperage of a circuit is exceeded is called _____.
5. The _____ is the point where electricity enters a building.

6. _____ occurs when electricity is carried through conductors for long distances. It is a result of the resistance in the conductors.

7. The _____ establishes guidelines for electrical wiring to ensure the safe use of electricity.

Instructions: Provide information to answer the following questions.

1. What are two places where alternating current electricity is used?

2. What are two places or applications where direct current is used?

3. What are five safety practices that one should observe when working?

Finding Volts, Watts and Amps

Instructions: Match the term with the correct response. Write the letter of the term by the definition.

- | | |
|---------------|------------------------|
| a. resistance | d. amperes |
| b. watts | e. multimeter |
| c. ohms | f. electromotive force |

- _____ 1. A device used to measure two or more electrical characteristics.
_____ 2. Term used to measure electrical power.
_____ 3. Referred to as voltage. It is what causes electrons to flow through a conductor.
_____ 4. A measure of the rate of electrical current flow.
_____ 5. The characteristic of any material to oppose the flow of electricity.
_____ 6. Term used to measure the amount of electrical resistance.

Instructions:. Provide the word or words to complete the following statements.

1. A _____ is used to measure voltage in a circuit.
2. A kilowatt-hour is equivalent to using _____ watts for one hour of time.
3. Ohm's Law is an equation used to describe the relationship between ohms, _____ and _____.
4. An ammeter is used to measure _____ in a circuit.
5. The power equation is used to describe the relationship between _____, _____, and _____.

Instructions: Provide information to answer the following questions.

1. What term is associated with each of the following used in the Power Equation and Ohm's law?

P= _____

I= _____

E= _____

R= _____

2. Given a 120 volt circuit with three 100 watt light bulbs, how many amps of current are flowing through the circuit?

3. How many volts would be in a circuit that has electrical devices using a total of 1,500 watts with 13.6 amps of current?

4. How many ohms of resistance are in a 115 volt circuit that is using 14.5 amps of current?

5. How much would it cost if you accidentally left two 75 watt light bulbs turned on in an attic for a period of 30 days, assuming that electricity cost \$.07 per kilowatt-hour?

6. How many watts of electricity are being used on 120 volt circuit that is using 17.5 amps of current?

Calculating Cost of Electricity

Purpose:

Students will learn the relationships between watts, volts, amps, and ohms by using the Power Equation and Ohm's Law to calculate various electricity problems.

Problems:

1. Determine how many amps of current are flowing through a 120 volt circuit that is using 1,650 watts of electricity.
2. How many volts are required in a circuit that uses 9.6 kilowatts of power with 40 amps of current flowing?
3. How many ohms of resistance are in a toaster on a 120 volt circuit that has 6.7 amps of current flowing?
4. How many watts of power are being used in a 240 volt circuit that has 36 amps of current flowing?
5. How many amps of current are there in a 100 watt light bulb on a 120 volt circuit?
6. Given an appliance that has 12.8 ohms of resistance, how many amps of current are flowing in a 120 volt circuit?

Purpose:

Students will learn the how to determine the cost of using various electrical devices.

Problems:

1. How many kilowatts of electricity are used in one week when a 5,000 watt clothes dryer is used for 2 hours per day?

2. How much would it cost to watch your television for one week if you averaged watching it for 5 hours per day? The television is rated at 250 watts and electricity costs \$.07/kwh.

3. How much does it cost to operate a food freezer for one month (30 days) if it averages 6 hours of operation per day? The freezer is rated at 650 watts and electricity costs \$.09/kwh.

4. How much does it cost to keep a swine confinement building lighted at night for one year (365 days) if the lights are kept on an average of 10 hours per day? There are six 150 watt light bulbs used for lighting and electricity costs \$.12/kwh.

5. How much does it cost to operate computer monitor that is left on continuously for 1 month (30 days) if it is rated at 1.6 amps on a 120 volt circuit? Assume electricity costs \$.07/kwh.

6. Determine the cost of operating a 600 watt sump pump in an aquaculture system if the pump is used continuously for 9 months. Electricity costs \$.08/kwh.

Lesson 4	Review of Scale Factor	
Time Estimate: 2 hours		
Objectives		
<ol style="list-style-type: none"> 1. Students will understand the concept of scale factor. 2. Students will be able to draw basic figures to a given scale. 		
Materials & Resources		
<ul style="list-style-type: none"> • Handout 6, Scale Drawing Spreadsheet • Graph Paper for Scale Drawing 		
Agenda		
<i>Step</i>	<i>Minutes</i>	<i>Activity</i>
1	25	<ul style="list-style-type: none"> -Review the basic concept of scale factor. -Highlight ratios and proportions as a method of finding the "new" dimensions.
2	15	<ul style="list-style-type: none"> -Distribute Handout 6, Scale Drawing Spreadsheet. -Students are to take measurements of the classroom and record them on the handout.
3	15	<ul style="list-style-type: none"> -Working in small groups, have students determine an appropriate scale factor to use. -Have them convert their actual measurements of the classroom to the scaled measurements.
4	45	<ul style="list-style-type: none"> -Distribute graph paper. -Have students use their scaled measurements to create a scaled drawing of classroom on the graph paper.

Scale Drawing Spreadsheet

Selected Scale: _____

Classroom Item	Actual Measurement	Scale Measurement
Wall 1		
Wall 2		
Wall 3		
Wall 4		

Lesson 5		Drawing to Scale
Time Estimate: 5 hours		
Objectives		
1. Students will be able to draw more complicated items to an appropriate scale.		
Materials & Resources		
Handout 7, Scale Drawing Spreadsheet for Computer Lab Spreadsheet from Lesson 2 Graph Paper for Scale Drawing		
Agenda		
<i>Step</i>	<i>Minutes</i>	<i>Activity</i>
1	10	-Distribute spreadsheet information from Lesson 2 and discuss and answer any questions.
2	20	-Distribute Handout 7, Scale Drawing Spreadsheet for Computer Lab. -Students will input data into the spreadsheet. -Students will determine an appropriate scale factor. -Students are to convert the actual measurements to scaled measurements.
3	70	-Distribute graph paper and have students use the scaled data to create a scaled drawing of the computer lab. -Place the items in the most efficient manner. Keep in mind this should be most conducive to the students using them as well as the teacher attempting to monitor the students.
4	180	-After completing the scale drawing, students will then create a 3-D scale model of the computer lab. This should be as professional in appearance as possible as it along with the scale drawings will be used in the final presentation.

Scale Drawing Spreadsheet

Selected Scale: _____

Computer Lab Item	Actual Measurement	Scale Measurement
Wall 1		
Wall 2		
Wall 3		
Wall 4		

Lesson 6		The Total Computer and Equipment Solution
Time Estimate: 2 - 50 minute class periods		
Objectives		
1. Students will complete the total list of computer, router, and switch configuration for the new Wireless LAN project.		
Materials & Resources		
<ul style="list-style-type: none"> • Computer with Spreadsheet Software • Information produced in Lesson 2 • Information from Lesson 4 regarding Costs of Electricity • Information from Lesson 5, Scale Drawing 		
Agenda		
Step	Minutes	Activity
1	10	-Review all of the computer requirements to include computers and peripheral devices such as scanners, printers (black and white and color), any presentation hardware (overhead projection or smart board).
2	35	-Go to the computer lab and create the master cost spreadsheet for computer equipment.
3	35	-Using information from scale drawing and electricity costs, have students add power and furniture cost information to the master cost spreadsheet.
4	20	-Have students review all information to assure data correct, complete and make any revisions or recommendations.

Lesson 7		Preparing and Making a Business Presentation
Time Estimate: 4 - 50 minute periods		
Objectives		
<ol style="list-style-type: none"> 1. Students will be introduced to the Business Presentation process. 2. Students will develop and deliver a presentation. 		
Materials & Resources		
<ul style="list-style-type: none"> • Information Making a Business Presentation: Copies of Preparing Presentations (can be downloaded at www.tdlmathscience.org/q=node.17.) • Computer with presentation software 		
Agenda		
Step	Minutes	Activity
1	25	<ul style="list-style-type: none"> -Give students the handout of the Making a Business Presentation document from the web. -Have students reach each section and discuss as a class.
2	50	<ul style="list-style-type: none"> -Organize students into groups to organize all of the data and finalize the presentation. -Specific responsibilities for putting the presentation together should be assigned to each group member.
3	50	<ul style="list-style-type: none"> -Students will meet in groups and begin to assemble the final presentation and critique work. -Allow time for students to prepare the presentation in PowerPoint or other presentation software.
4	50	<ul style="list-style-type: none"> -Schedule presentations to school administrators, teachers, superintendent, business partner and the school board. -Have students make presentations as scheduled.
5	20	<ul style="list-style-type: none"> -Get feedback on presentation and materials from audience and students.

Teacher

Assessment Materials

FINAL EVALUATION

Problem Statement to be solved

New Athens High School Board has asked the Superintendent to explore the feasibility of upgrading the existing computer lab to a wireless computer lab with state of the art workstation facilities. The Superintendent has approached the Math Department to take the lead and our Agriculture Department to provide support for this initiative. The feasibility study should include scale drawing and model and a list of materials and services needed with costs. This is to be presented to the administration and the School Board.

Final Evaluation Criteria

1. Equipment needs that address all aspects (computers, furniture and environmental issues). Computers must include CPU (processor speed, DRAM and storage/hard drive size); monitor (size and capabilities); and network connectivity (wired or wireless, physical media and speed of connection).
2. A list of materials and services required to complete a complex IT project was developed.
3. Cost of the project is included in the presentation.
4. Each member of each team can answer questions about the phases of the business plan or is familiar enough with the sources to find the answer to any question.
5. All calculations are backed up by the appropriate pricing document.
6. A professional business presentation is developed that contains visual aides.

Scoring Guide

- | | |
|---|-----------|
| 1. Completed list of equipment, materials and services needed | 20 points |
| 2. Scaled Model | 20 points |
| 3. Cost Estimates complete and accurate | 20 points |
| 4. Presentation | 40 points |