Sample Completed Integrated Lesson/Project Template

(For integrated project examples following this template, please refer to www.stemtransitions.org.)

Major Sections	Content
Overview	**Unit of Instruction:** Multi-step Problem-Solving for Business Math **Lesson Title:** Product Storage Cost-Benefit Analysis **General Description/Purpose:** Students will work in collaborative teams using mathematics and critical thinking skills to evaluate warehousing options for a hypothetical company. **Estimated Timeframe:** 5 hours (at instructor's discretion) **Key Terms** Warehousing and Distribution, Business Management, Cost-Benefit Analysis, Inventory Management, Logistics Management. **Student Learning Objectives**: Learners will be able to: • Demonstrate basic understanding of cost-benefit analysis • Identify appropriate variables (from a multi-variable problem) for inclusion in equations • Create and work equations to obtain possible solution • Analyze and compare potential solutions • Use a table or spreadsheet format to record data • Work collaboratively to determine the best solution • Demonstrate critical thinking skills when presenting group's rationale for solution to the class **Standards/Skills Addressed**: *Academic Standards/Skills* •Perform a series of basic math operations (working with whole numbers, decimals, simple algebraic equations) •Solve mathematical problems presented in the context of real-world situations. •Conduct research, gather data and represent it accurately. •Analyze and draw conclusions from collected data.

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	Technical Standards/Skills • Prepare, process, and store incoming and outgoing goods and materials. • Identify potential locations. • Evaluate alternative locations and determine service level and cost differences. • Develop warehousing solutions to meet customer and business requirements. • Project short-term and long-term demand for warehousing services including the volume and flow of goods and materials to and from warehouse(s). • Determine scheduled volume and flow of outbound products • Manage inventory according to company policies and customer requirements. • Determine required inventory levels to meet projected demand • Present and explain information on location process and decisions (e.g., business meetings). *Employability Standards/Skills* •Teamwork – Students will work in teams to determine the costs, benefits, and disadvantages of different warehousing options. •Critical Thinking – Students will need to look beyond the economic value of each option to include the advantages and disadvantages of a private versus public warehouse.
Equipment/Materials	**List of Materials and Equipment**: •Reference books and materials as selected or created by the instructor •Possibly access to computers with the following applications: •Word processing software such as MS Word •Spreadsheet software such as Excel •Presentation software such as PowerPoint •Internet access
Discussion	**Industry Scenario/Real-World Context:** Student works for an industrial coatings manufacturer in the inventory control department. The company has outgrown its warehouse, a 100,000 sq. ft. temperature-controlled, dust-free facility. The nearest public distribution center that could accommodate the product and its storage requirements is 110 miles away. The student will be part of a collaborative group that has been assigned to research and calculate data associated with the feasibility of different warehouse options for their company.

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	Proposed Teaching Strategies: CORD's Contextual Teaching and Learning "REACT" Strategy: **Relating:** Discuss decision-making as a consumer. Introduction to cost-benefit analysis. **Experiencing:** Activity in which learners address questions like: How do you decide which cell phone to purchase? How do you know which plan is best for you? **Applying:** Activity in which learners apply the concept of cost-benefit analysis to a problem within the context of operating a warehouse. **Cooperating:** Learners will work in teams to discuss variables, solve problems, and determine the most cost-efficient solution for the business. **Transferring:** Use of the skills learned in this lesson to solve a problem in another business context.
Activities	**Activity Preparation:** (Pre-lesson): • Provide vocabulary list and discuss the words—such as cost-benefit, break-even, return on investment, cost per unit, supply chain—in the context of learners' life experience. • Review fractions, decimals, percents and basic algebra (finding an unknown). • Provide a scenario for the activity that includes multiple known quantities, e.g. *Rainbow Colors, an industrial coatings manufacturer, has outgrown its warehouse, a 100,000 sq. ft. temperature-controlled, dust-free facility. The nearest public distribution center that could accommodate the product and its storage requirements is 110 miles away.* ***Key Facts to give students who will use them to identify relevant variables*** *•There are approximately 300 different SKU's (stock keeping unit) in the warehouse and Rainbow Colors maintains an inventory of 500 of each SKU.* *•The SKU's are all the same size and weight – 8 pounds. (Each SKU is stored in a container very similar to a gallon of paint.)* *•The private warehouse cost of storing each SKU is $.21 per month.* *•The public distribution center 110 miles away has suggested a storage price of $.09 per SKU per month storage and $.04 per SKU handling fee per month.* *•The cost of transportation is $350 per truckload to move to the public distribution center.* *•A truck can carry up to 44,000 pounds.* *• Cost to build new facility:* o *Total Land Cost: $50,000* o *Building Costs: $1 million* o *Warehouse Equipment: $500,000* o *Office Equipment: $50,000* o *Total: $1.6 million*

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	Activity Steps: In small collaborative groups, learners should discuss the information in the scenario, examine warehouse options and determine the best business decision for Rainbow Colors. Option 1: Rent space in the public distribution center to accommodate entire inventory. Be sure to take into account (calculate) the cost to move the inventory from the old warehouse to the new warehouse. Option 2: Enlarge current operations and build a new plant warehouse. The estimated cost to build is $1.6 million dollars. This new warehouse would be two times the size of the existing warehouse which is at full capacity now. With the present growth of the business, the new warehouse would be at full capacity in 15 years. The construction would take one year and the company's ROI requirement is 12%. Each group's products from the activity will include: • Identification of appropriate variables for analysis within a cost-benefit scenario. • Creation and working of equations in order to compare potential solutions. • Comparison of potential solutions using a table or spreadsheet format. • Written documentation the group's work. • Presentation of the group's findings to the class. Instructor will spend time throughout the process with each group—guiding, answering questions, monitoring progress, and re-directing as needed. **Wrap-up (pre-assessment):** There are many opportunities for ongoing assessment of understanding throughout the activity, i.e. learner questions at the introductory session; observations during the instructor walk-about; content of written essays prior to the group presentations. Instructor will determine what to re-teach and when the class is ready for a summary (wrap-up). **Expected Results:** Learner products: • Demonstration of basic understanding of cost-benefit analysis • Identification of appropriate variables for analysis within a cost-benefit scenario • Creation and working of equations in order to compare potential solutions • Comparison of potential solutions using a table or spreadsheet format • Teamwork to decide upon the most cost effective solution • Written documentation the group's work • Presentation of the group's findings to the class

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	Extension Options: • Investigate basic energy efficiency measures for warehouses, as well as building practices required to become LEED™ (Leadership in Energy and Environmental Design) certified. • Research Radio Frequency Identification Devices (RFID). How is RFID being used in the distribution and logistics industries?
Faculty Resources	**Background Material:** Faculty prerequisite knowledge: In addition to strategies relevant to teaching foundational basic skills, instructors should have a general knowledge of warehousing issues. Potential resources— *Warehouse Management: A Complete Guide to Improving Efficiency and Minimizing Costs in the Modern Warehouse*—textbook by Gwynne Richards **Handouts and Supplemental Materials:** Handouts: • Cost-benefit analysis worksheet • Critical thinking questions • Group activity instructions and expectations • Spreadsheet or table for comparisons • Problem-solving checklist • Rubric with expectations for written essay • Rubric with expectations for group presentation PowerPoint presentation which includes details about the vocabulary and industry scenario **Suggested Website Links:** "How to Do a Simple Cost-Benefit Analysis" http://www.purchasing-procurement-center.com/cost-benefit-analysis.html
Assessment	**Learner Products, Assessment Tools or Processes:** • Demonstration of basic understanding of cost-benefit analysis — INITIAL CELL PHONE ACTIVITY DISCUSSION PARTICIPATION + WORKSHEET DOCUMENTING THOUGHT PROCESS; WRITTEN FORMATIVE ASSESSMENT "EXPLAIN COST-BENEFIT ANALYSIS IN YOUR OWN WORDS" • Identification of appropriate variables for analysis within a cost-benefit scenario—WORKSHEET WITH CRITICAL THINKING PROMPTS. e.g. what do we know (key facts, data); what do we need to know? • Creation and working of equations in order to compare potential solutions—WRITTEN DOCUMENTATION OF VARIABLE SELECTION,

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	INCLUSION IN EQUATIONS, AND CORRECT SOLUTIONS • Comparison of potential solutions using a table or spreadsheet format— SIDE BY SIDE COMPARISON OF TWO POTENTIAL SOLUTIONS • Teamwork to decide upon the most cost effective solution— PROBLEM-SOLVING CHECKLIST • Written documentation the group's work— WRITTEN ESSAY OR REPORT WITH RUBRIC • Presentation of the group's findings to the class— CLASS PRESENTATION WITH RUBRIC