APPENDIX G:
Cross-Content Workplace Readiness and Systems Thinking

ILLUSTRATIONS OF THE INTERDISCIPLINARY, SYSTEMS THINKING APPROACH

The following three vastly different scenarios illustrate the interdisciplinary, systems thinking approach. Although they are presented in elementary, middle, and high school categories, the scenarios can be adapted to other developmental levels through the creativity of the teacher/facilitator. **The use of a world language can be effectively incorporated into all of these scenarios. The level of language sophistication needs to be adapted for the specific benchmark grades (K-4, 5-8, and 9-12).**

Elementary School Level: The Pyramid Reconstruction Systems Thinking Project

The primary task of this project is to engage students in Grades 3 and 4 in an activity that provides them with an opportunity to discuss and debate the system support mechanism that needed to be in place to allow the great pyramids of Egypt to be constructed.

Note: Student problem-solving and thinking processes are the important aspects. This activity also focuses on the ability to communicate the results to other members of the class.

Background. The Great Pyramids of Giza, built over 4,500 years ago, continue to impress modern-day engineers and technologists. These tombs are the most famous pyramids, but there are more than 80 other pyramids in Egypt. The largest of the three, the Great Pyramid of King Khufu, was built about 2550 B.C. At its peak, it was 481 feet tall and had a square base of 756 feet on each side. Approximately 2,300,000 blocks of solid limestone, each weighing about 2.5 tons, were used in its construction. Many scholars have offered theories on how the Egyptians accomplished their construction; however, there is no definitive proof substantiating their findings.

The problem. The ancient Egyptians were faced with many problems while building the pyramids at Giza 4,500 years ago. One of the most obvious problems that they had was moving heavy blocks of stone (about 2½ tons each) into position to build the pyramid. The largest pyramid at Giza is over 450 feet high and used over 2 million stones. To imagine how high the pyramids actually are, they would be more than 1½ football fields standing end on end. ***The problem is to discover a successful technique to move a large stone up an inclined plane.***

The materials. A stone, an inclined plane, sand, water, rope, and wood are the materials needed for this project.

Quality workers. The Egyptians needed to be quality workers. Clearly, their finished project is evidence of their ability to work both individually and in teams. Obviously, the Egyptians understood a great deal about technology and practical problem solving; they were critical thinkers who knew how to make decisions. We know that there was division of labor among the ancient Egyptian workers. For example, there were surveyors, stone cutters, rope pullers, engineers, and architects and designers.

The ancient Egyptians worked on the pyramids only three months of the year, when the Nile River overflowed. Workers demonstrated self-discipline and self-management skills. The Egyptians needed to be safety-minded to insure that the people who were doing this dangerous work would not be hurt.

Sample connections. Identified below are some examples of how the classroom teacher may emphasize various content areas around this specific activity and theme.

The Arts (Visual and Performing)—Elements of design and aesthetics in the beauty of the pyramid itself may be explored. For example, the interior walls were decorated with paintings. Some of the objects found within the pyramid might be art or artistically designed products.

Comprehensive Health and Physical Education—Students may explore the diet of the ancient Egyptians in explaining how they were physically and mentally fit for this arduous task.

Language Arts Literacy—Although students will use all of their language arts literacy skills throughout this activity, emphasis may be placed on the student's ability to speak to his or her audience during a culminating presentation on the activity. Further research on topics of interest to the student may be pursued.

Mathematics—Students will explore the importance of geometric shapes and properties in designing the pyramids.

Science—Students will explore the impact of how the needs of the building system were satisfied by a variety of services. Students can construct a chart or diagram that illustrates a variety of system components that would be necessary to support the building project. Include items such as where the water to drink would come from and how it would have been transported and stored. Groups of students can discuss, research, and present to the class a variety of system needs, conveying what, where, and how much of the support would have been needed for the project. Discuss the principles of levers and wheels.

Social Studies—The Egyptian culture will be explored. Students will examine the significance of the pyramids as well as how human beings learn to work together in teams. (It is estimated that between 40,000 and 50,000 people worked collaboratively on the goal of completing the pyramid.)

World Languages—Students will explore related aspects of the Egyptian culture that required early settlers from different communities on the Nile to agree to use hieroglyphics to assist their interaction for the purposes of economics, agriculture, and the building of the pyramid. **World language use should reflect the outcomes indicated in the cumulative progress indicators for grades K-4 (e.g., "Describe people, places, things and events using short phrases and simple sentences.").**

Middle School Level: The Real Game

Forty-six New Jersey school districts participated in "The Real Game" pilot program in April 1998. The Real Game is a hands-on, practical, experiential learning program that allows students to experience various aspects of the working world by using role playing and game devices. It is cross-curricular and designed for middle and junior high school classes (primarily seventh and eighth grades) with a maximum of 40 students. (Additional versions, ranging from Grade 1 through adult, are currently being planned, developed, and/or field tested by the National Occupational Information Coordinating Committee [NOICC].) Through a series of interdisciplinary exercises and events guided by teachers or counselors, students become more aware of the world of work and how their actions in school affect their futures. Anecdotal records from New Jersey teachers indicate that content area teachers have reported increased student interest in academics as they begin to see the relevance of their studies to life. **World language use should reflect the outcomes indicated in the cumulative progress indicators for Grades 5-8 (e.g., "Organize thoughts into coherent oral speech.").**

How does The Real Game work? Each of the five units is described below.

Unit 1: Learning a living. In this first unit, the students are given an overview of The Real Game. The game is presented as a journey in career exploration that will bring the students to "assume the mantle of the expert." The students are informed that they will, through a randomly chosen occupation, explore aspects related to adult life in our society. In order to assess their current knowledge of terminology and other aspects related to the work world, students complete a questionnaire. (They fill out the same questionnaire at the end of unit 5 to evaluate their progress.) The students play the first round of The Spin Game (an interdisciplinary multiple-choice question-and-answer game) and form groupings that serve as the basis of many subsequent activities for The Real Game program.

Unit 2: Making a living. In the second unit, the students really take on their roles. Four activities help them to gradually imagine themselves as adult workers. First, the students explore and express their dreams by choosing items on the Wish List that they would like to have in their adult life. Reality comes into play when students have to balance their monthly budgets (by applying their mathematical skills) and assess what they can actually obtain while taking income and chance (represented by Chance Cards) into consideration. The students then start to personalize their Activity Poster as they gather information on their neighbors' occupations. Some elements on the Activity Poster include transferable skills, annual holidays, gross and net monthly income, income tax, bills, and expenses.

Unit 3: Quality of life. In unit 3, the students choose leisure and holiday activities while still taking into account the profile assigned to them. They examine their necessary daily activities and then choose activities to do during their free time. The students then plan a group holiday while taking into account their budget and the amount of vacation time each member has. This is an exercise in negotiation that will give them the opportunity to research specific destinations as well as a variety of occupations in the travel industry.

Unit 4: Changes and choices. By participating in this unit's five activities, the students are made aware of unexpected elements that occur in the work world and in life. Unforeseen circumstances change the course of the game as students must offer support and assistance to colleagues who are faced with a job loss. Activities such as group discussions and essays help students think of positive actions that may bring new possibilities. Finally, the entire class is rendered jobless by large-scale disasters. While working as a team, the students offer solutions and learn how their transferable skills will enable them to grasp other opportunities. The students then play the second round of The Spin Game so that they may continue to explore the occupations, terminology, and links that exist between their schooling and the work world.

Unit Five: The personal journey. In the last unit of the Real Game, the students imagine themselves in the future and must reflect on their career journey by talking with individuals in the community. Guest speakers are invited to a Career Day. Activities such as these enable the students to share their experiences and new knowledge as well as gather information on the present work world and a variety of careers.

High School Level: The Life Cycle of a Pencil

Activity. Provide each student with a wood pencil. Have them brainstorm on the board a list of materials that make up the pencil, along with the natural resources from which they are derived. Ask them where these natural resources and other materials come from. Discuss possible origins, and locate these on a world map. Have the students learn the word for pencil in the languages of each country and determine whether pencils are in fact used in each country. **World language use should reflect the outcomes indicated in the cumulative progress indicators for Grades 9-12 (e.g., "Communicate orally with increasing logic and accuracy.").**

A list of the components of a wood pencil and their possible origins is provided below:

- Copper - Canada
- Incense Cedar - California
- Petroleum - Saudi Arabia
- Zinc - Poland
- Graphite - Sri Lanka
- Gum (sap) - Mexico
- Clay - Mississippi
- Rubber - Brazil
- Pumice - Italy

Discuss with students the appropriate first aid if someone is accidentally stuck with a pencil. Then have the students consider the life cycles of a wooden lead pencil "from cradle to grave." Where do the makings of a pencil begin? Where does a pencil stub go? Draw a large circle on the board with a pencil in the middle of it. Locate steps regarding the formation, use, and disposal of a pencil in appropriate areas around the circle. Sample steps are given below:

1. Wood is harvested; truck hauls tree to mill.
2. Mill prepares lumber; lumber is shipped to factory.
3. Graphite is mined and shipped to factory.
4. Clay is mined and shipped to factory.
5. Gums are tapped, prepared, and shipped to factory.
6. Pencils are manufactured.
7. Trucker hauls pencils to warehouse or railroad.
8. Trucker hauls pencils to wholesale dealers.
9. Trucker hauls pencils to retail stores.
10. Customer drives to store to buy pencils.
11. Customer uses then discards pencil.
12. Pencil hauled to landfill or incinerator.

Have the students identify the forms of energy (including human) required to extract, process, manufacture, and transport the pencils. Identify various modes of transportation that are available. Identify where materials might be reused or recycled. Throughout the process, identify and research related careers. These other activities usually require a smaller set of steps and can be drawn as smaller concentric circles overlapping with larger circle.

Have the students provide examples of feedback that can be obtained throughout the "life cycle of a pencil." Have the students explain how that feedback is used to control, alter, or effect the behavior of a system. Examples include the following:

- overall demand for, and sales of, pencils;
- seasonal fluctuation of pencils, or decrease or increase of sales;
- availability of refillable, plastic pencils and the subsequent need to find new markets for lead pencils;
- increased postage for shipping;
- increased gasoline prices for hauling;
- reduction of the environmental impacts of graphite mining, which causes a rise in production costs;
- development of a new technology that is only feasible if more pencils are produced (finding new markets becomes a priority);
- use of only recycled materials in designing pencil packaging; and competitor's reduction in price per pencil, which necessitates cutting of production costs.

Extension Activities. Identify materials that are generated or produced in your local community. Have groups of students select one and research its origins, use, and disposal from "cradle to grave." Multiple sources of information from the library media center and the community should be accessed, including local tours, visuals, interviews, the Internet, etc. Have students present their findings using a variety of media. Identify and research related careers. Invite guest speakers to address the students at a career day.

Reference. This activity was adapted from "Resource-Go-Round," a *Project Learning Tree Activity Guide* (pp. 316-319).