24. Agriculture: Internet Resources for Educators

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Two workshops exposed secondary school teachers to the multidisciplinary domain of agriculture and to new opportunities to revitalize their mathematics and science curricula. These workshops were centered on an Internet-based platform and provided participants structured, as well as unstructured, activities. This approach worked well in terms of introducing the subject of agriculture to many who had never been exposed prior to attending the workshops, as well as providing insights about incorporating these ideas into current or new classroom materials. This chapter provides my reflections on these workshops and includes feedback from participants. Furthermore, to make this approach accessible to an audience greater than the domain of the workshop participants, it also provides a resource for educators by offering an extensive list of websites that can be used to investigate agricultural concepts.

Most participants began the sessions with a perception that agriculture entailed only grain production and livestock rearing. They soon discovered, however, that production farming was only a small sector of the much larger agribusiness foundation upon which our entire society actually rests.

Justification

Educators who participated in the two workshops were interested in developing innovative classroom materials and felt that agriculture, while unknown territory for most, might prove to be fertile ground for these endeavors. Specifically, they needed to bolster their efforts to improve the mathematics, science, technology, and communication skills of their students and hoped to gain information and applications that could be integrated into their own materials and teaching modules.

Workshops

The eight-hour workshops introduced secondary educators to agriculture and provided them with a fresh resource base from which they could build innovative teaching materials. Each workshop used a three-step approach. Following the online agenda, I introduced a specific topic with a short, directed discussion. Then participants were directed to several Internet sites to learn more about that topic. Participants could freely browse the Internet for related information. After approximately 30 minutes of online research, a class discussion ensued where participants shared information and useful website addresses.

What Is Agriculture?

Traditional agriculture, at least in the United States, has typically entailed grain and livestock farming. While modern agriculture still includes these primary activities, it encompasses a much greater range, and comprises all aspects of the food, feed, and fiber industries that nourish and clothe our population. Thus, agriculture can include diverse disciplines such as:

- Accounting
- Agronomy and soil science
- Animal science
- Biology
- Biosystems and biomedical research
- Building structures, construction, and environmental design
- Business and management
- Chemistry
- Economics
- Ecology
- Electronics and instrumentation
- Engineering
- Environmental systems and natural resources
- Food science and processing
- Genetic engineering and biotechnology
- Law
- Machine design and manufacturing
- Mathematics
- Modeling and simulation
- Physics
- Plant breeding and pathology
- Statistics
- Surveying
- Veterinary sciences

This list, however, provides only a small sampling of the broad scope of contemporary agriculture. Table 1 lists websites for exploration of the extent to which agriculture has expanded beyond the confines of traditional farming. (Tables listing the websites are in the appendices at the end of this chapter.)

Careers in agriculture

Because agriculture encompasses more than just the traditional occupation of farming, career possibilities for college graduates, even those who did not study agriculture while in school, are numerous. Table 2 provides several websites to explore some of these opportunities.

History of agriculture

In 1840, Daniel Webster said, "When tillage begins, other arts follow. The farmers, therefore, are the founders of civilization." His statement was quite true. Civilization began when hunting and gathering tribes settled near rivers to cultivate grain and domesticate livestock. Agricultural history can offer a bountiful harvest of educational possibilities for classrooms (Table 3).

Agricultural technologies and innovations

Modern agriculture, like other segments of our society, is heavily influenced by technological innovations and inventions. A few examples include agricultural production, agricultural processing, flowcharting, modeling and simulation, biotechnology, and geographic information systems, all of which will be discussed in more depth.

Agricultural production

The United States is one of the world's foremost food producing nations. Production is the first step in the food supply chain (Figure 1). In traditional agricultural settings, this has generally entailed only grain and livestock farming. Today, however, it includes all aspects of production that provide raw material inputs into the commercial market stream, including grain, meat, fruit, vegetable, fiber, and pulp. Raw products require processing before they can be consumed or used. Table 4 provides websites that can be used to examine modern agricultural production techniques, processes, and practices.

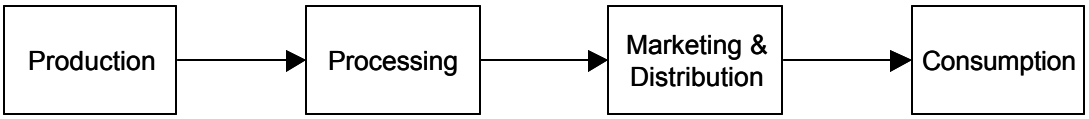


Figure 24.1 Food Supply Chain

Agricultural processing

Processing is the second step in the supply chain (Figure 1). It entails the conversion of raw materials into partially finished products, which become input for other manufacturing and processing steps, or completely finished goods ready for the consumer. Table 5 provides websites that can be used to explore processing strategies and techniques.

Flowcharting

Flowcharts, also known as flow diagrams, use graphic symbols to depict the nature and flow of steps, materials, or information in processes. Flowcharts are used extensively in agricultural and food production and in processing industries (especially during engineering and design stages), but are not limited to agricultural enterprises. Any process, in fact, can be deconstructed and described using this methodology.

Flowcharts can be constructed by several means: sketching, drawing with a template, or using computer tools. They may be simple (Figures 2 and 3) or complex (Figure 4).

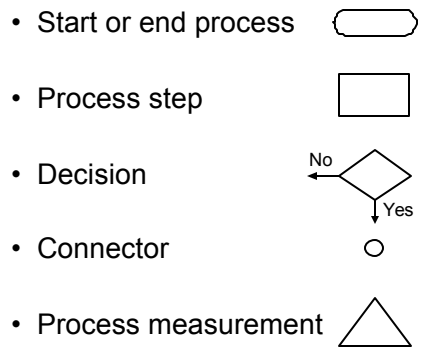


Figure 24.2 Fundamental Shapes Used to Construct Simple Flowcharts

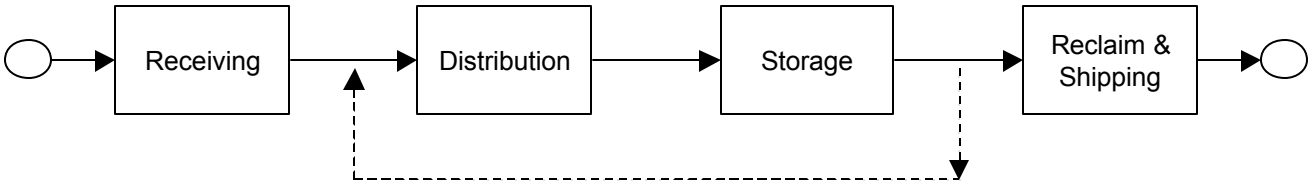


Figure 24.3 Simple Flowchart Depicting a Typical Grain Storage Facility

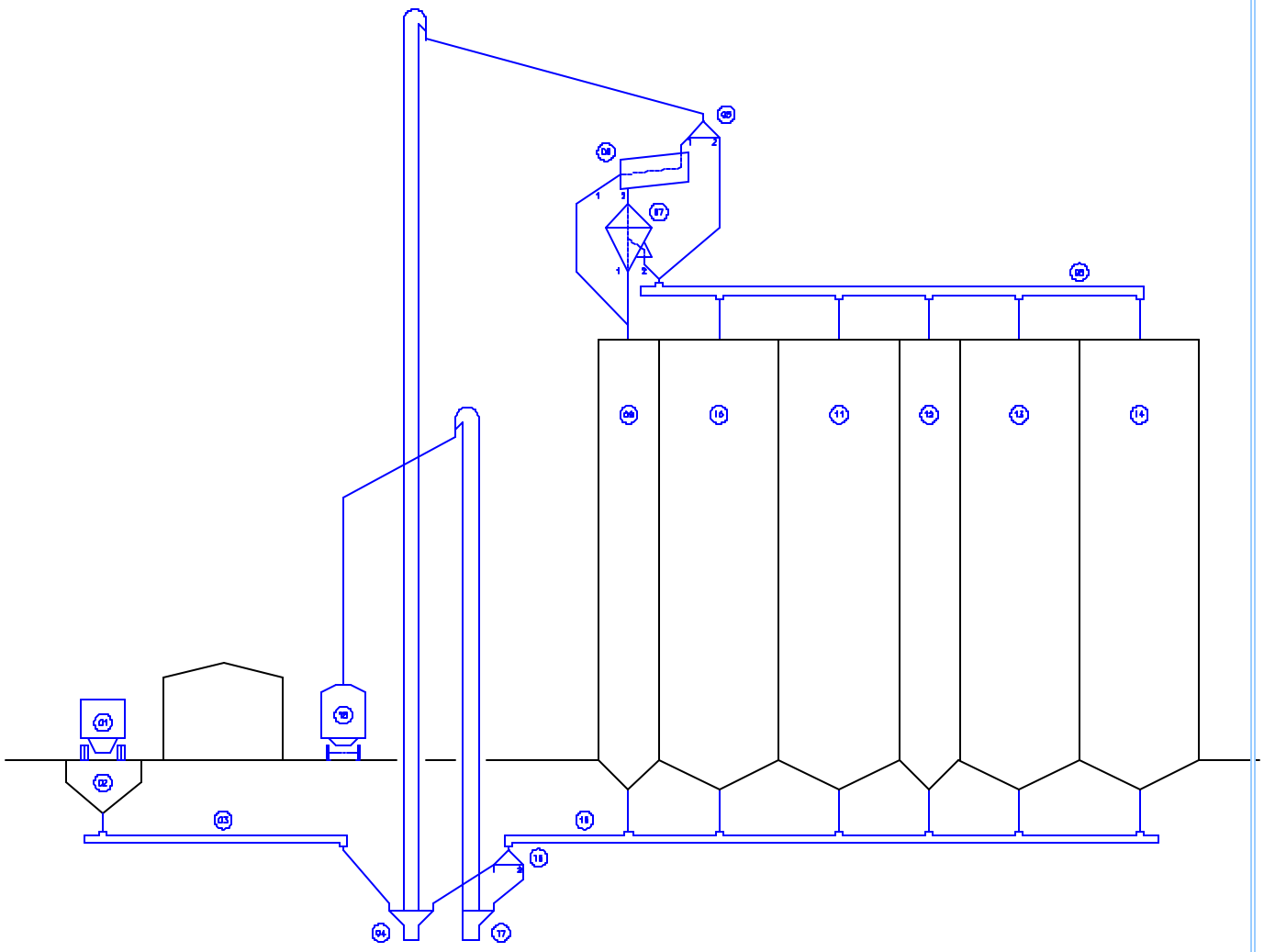


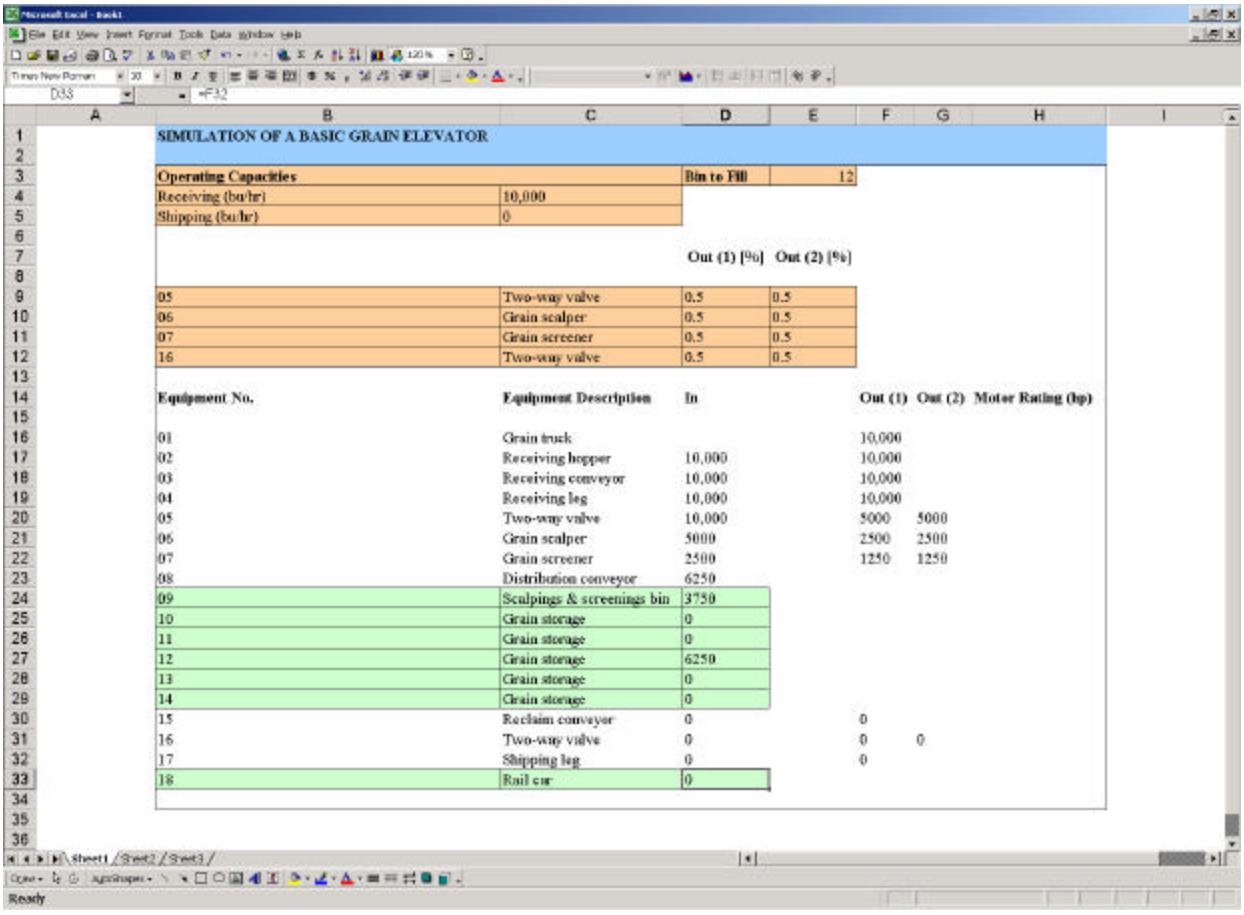
Figure 24.4 Complex Flowchart Depicting Typical Grain Storage Facility

After the Internet exploration phase of the session, we devoted a short applications session to train participants to make a flowchart. Table 6 provides websites that can be used to explore flowcharting techniques and strategies.

Modeling and simulation

Modeling and simulation are tools and techniques that use mathematical equations to quantify and represent systems, processes, and the flow of materials and information. This type of analysis can show how altering one step, several steps, the relationships between these steps, or process inputs can affect the behavior and performance of the entire system under investigation. It is used extensively to examine agricultural production and processing environments. Any system or process can be modeled and simulated, especially those that have been decomposed and depicted using flowcharts.

Many computer programs are available to accomplish this task, but an electronic spreadsheet can be used very effectively to construct relatively straightforward simulation models (Figure 5) by applying simple algebraic expressions to describe flow through the system. This methodology can be used for any system or discipline and can range from relatively simple to very complex in nature. Table 7 provides websites that discuss modeling and simulation in more depth.



SIMULATION OF A BASIC GRAIN ELEVATOR

Operating Capacities		Bin to Fill	12
Receiving (bu/hr)	10,000		
Shipping (bu/hr)	0		

		Out (1) [%]	Out (2) [%]
05	Two-way valve	0.5	0.5
06	Grain scalper	0.5	0.5
07	Grain screener	0.5	0.5
16	Two-way valve	0.5	0.5

Equipment No.	Equipment Description	In	Out (1)	Out (2)	Motor Rating (hp)
01	Grain truck		10,000		
02	Receiving hopper	10,000	10,000		
03	Receiving conveyor	10,000	10,000		
04	Receiving leg	10,000	10,000		
05	Two-way valve	10,000	5000	5000	
06	Grain scalper	5000	2500	2500	
07	Grain screener	2500	1250	1250	
08	Distribution conveyor	6250			
09	Scalpings & screenings bin	3750			
10	Grain storage	0			
11	Grain storage	0			
12	Grain storage	6250			
13	Grain storage	0			
14	Grain storage	0			
15	Reclaim conveyor	0	0		
16	Two-way valve	0	0	0	
17	Shipping leg	0	0		
18	Rail car	0			

Figure 24.5 Simulation Model Developed in an Electronic Spreadsheet for a Typical Grain Storage Facility

Biotechnology

More than a decade ago, scientists envisioned the development of foods and crops that incorporated the techniques of modern biotechnology. Human intervention could lead to improvements of these biological materials and could include foods with new and desirable characteristics, such as insect and herbicide resistance, or added value from enhanced nutritional and end-use properties, such as modified vitamin, oil, starch, or even pharmaceutical components.

We now have a number of such products in the marketplace. Food and grain producers have readily adopted these new products in the hope that they may help overcome problems

associated with a weak agricultural economy. The public, on the other hand, has met these novel biological materials with skepticism and resistance, arising mainly out of concern over the safe application of this new technology and the unknown side effects of gene manipulation. However, the large multinational corporations that have developed these products can allocate significant resources for research and development and see the overarching potential of these materials. What is the future of biotechnology? The debate over genetic modification will continue for several years, and the outcome may significantly affect the global food supply. To explore the controversies surrounding the use of biotechnology, workshop participants conducted a formal debate based on their own findings from their Internet explorations.

Table 8 lists websites that offer information regarding biotechnology, its impacts on society, consumer perceptions, and future directions and applications for this cutting-edge scientific discipline.

Geographic Information Systems

Geographic Information Systems (GIS) are software tools used for mapping and analyzing objects on the surface of the Earth, such as agricultural fields, forests, urban landscapes, building locations, and earthquake fault lines. GIS technologies integrate powerful database capabilities with the unique visual perspective of traditional maps. GIS can be applied to a wide range of public and private enterprises, especially for planning, designing, engineering, reducing costs, or making informed decisions.

In agriculture, GIS is used with global-positioning-system (GPS) satellites to examine field conditions. This allows farmers to apply specific amounts of fertilizer and chemicals to specific locations, which helps them implement efficient and cost-effective production practices. Additionally, farmers are able to determine crop yield at each point in a field, so that management decisions regarding fertilizer and chemical treatment can be specifically targeted the following year. The use of GIS for these purposes is known as precision agriculture. Table 9 provides websites that offer information for precision agriculture and GIS systems.

Augmenting Classrooms with Agriculture

Agriculture is a fertile but often unplowed resource for growing innovative teaching materials. Creative discussion materials, examples, display materials, and even homework and examination problems can provide abundant applications for science, mathematics, and communications-building exercises. Table 10 provides online examples of potential strategies for infusing agricultural concepts into curriculum materials.

Modeling

Workshop implementation hinged on a Web-based delivery platform. Each day's agenda was placed online, and each participant could access it from a computer in the laboratory where the session was conducted. Each agenda item provided a link to background information, discussion questions, and hyperlinks to additional sources of information on the Internet. After a formal, structured discussion to introduce each activity, participants were directed to explore the Web addresses. After a given amount of time, participants were encouraged to explore the Internet for

additional information that could help them develop their own curriculum materials. Participants were then refocused for a group discussion of what each found. They found this helpful, not only because they garnered new ideas and websites from others, but also because it gave them the opportunity to reflect on important concepts to which they had been exposed during their exploration activities.

Upon completion of the workshops, many participants decided to incorporate agricultural ideas and concepts into their curriculum materials. They organized their assignments and modules according to the Illinois State Board of Education learning standards, including:

- Know and apply the concepts, principles and processes of scientific inquiry. (11A)
- Know and apply the concepts, principles and processes of technological design. (11B)
- Know and apply concepts that explain how living things function, adapt and change. (12A)
- Know and apply concepts that describe how living things interact with each other and with their environment. (12B)
- Know and apply concepts that describe the interaction between science, technology and society. (13B)

The standards that were most appropriate to incorporating agriculture into mathematics education included:

- Describe numerical relationships using variables and patterns. (8A)
- Interpret and describe numerical relationships using tables, graphs, and symbols. (8B)
- Solve problems using systems of numbers and their properties. (8C)
- Use algebraic concepts and procedures to represent and solve problems. (8D)
- Organize, describe, and make predictions from existing data. (10A)
- Formulate questions, design data collection methods, gather and analyze data and communicate findings. (10B)

The standards that were most appropriate to infusing agriculture into writing education included:

- Compose well-organized and coherent writing for specific purposes and audiences. (3B)
- Communicate ideas in writing to accomplish a variety of purposes. (3C)

Results

After completing both workshops, participants attained an understanding of the overarching scope and breadth of agriculture. Several of the feedback comments reflected this:

- "Informative and thought provoking."
- "Will implement many ideas in biology and chemistry classes."
- "This was an excellent workshop. It gave me so many good ideas that it will be difficult to pare down everything I would like to try. I found many worthwhile websites because of the presentation."

- "This workshop was nothing like I expected. I expected tractors and farming and found agriculture covers so much more! The websites and information will be easily used in a unit."

The formal results from the structured evaluation questions also display the confluence of participant attitude. Out of 24 total participants during the two workshops, 83-96% were very well pleased with the time spent, while 4-8% were only somewhat pleased (see Figure 6).

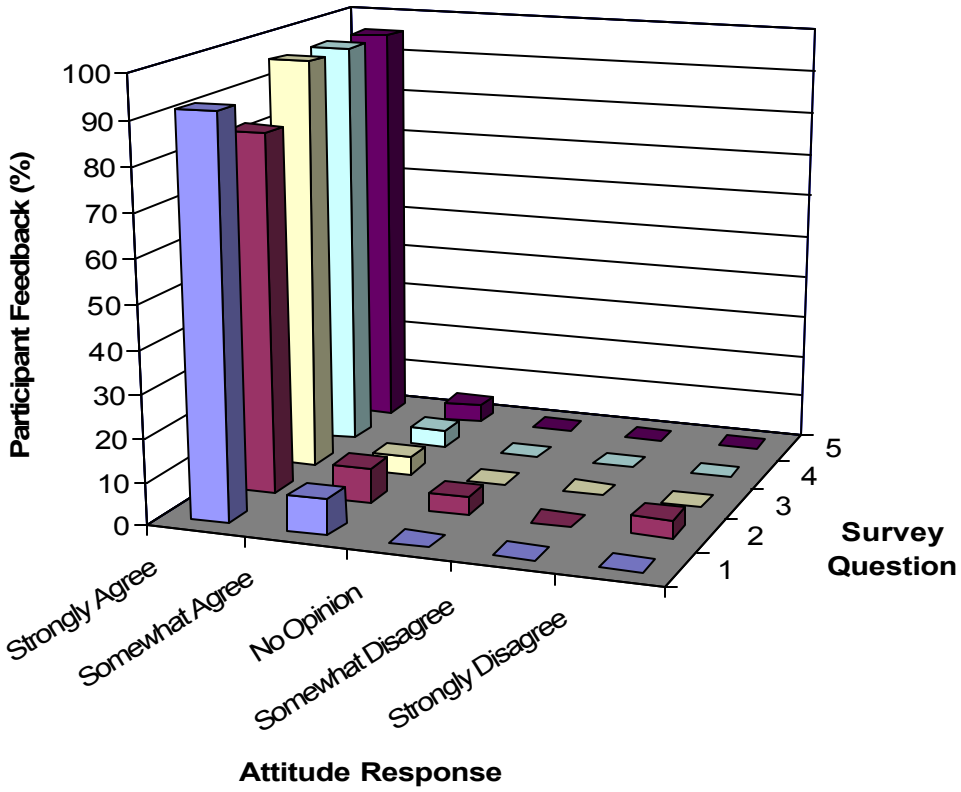


Figure 24.6 Ex Post Facto Workshop Evaluation Results

Many participants either planned to incorporate agricultural concepts into modules that they were developing or planned to construct new teaching modules dedicated to agricultural information garnered from their workshop experiences. Examples of planned curriculum activities included:

- Biology and chemistry exercises examining food processing operations
- Biology and chemistry exercises examining food production
- Examples and homework problems relating to nutrition, food, and organic chemistry
- Flowcharts to describe and solve mathematics problems
- Interactive games to teach disabled children about nutrition
- Mathematics story problems based on food processing systems

- Research papers on agricultural and food practices in various countries
- Research papers on agriculture, food, technology, and human development throughout history
- Research papers on food, economics, politics, environmentalism, and world hunger

The greatest benefit for many participants was the realization that agriculture is an unexplored, multidisciplinary resource for their teaching.

Side Payments

Developing and presenting these workshops benefited both the participants and the professor. The primary side payment was an effective, hands-on, Internet-centered delivery model for workshops that can be used as a paradigm for future endeavors. It worked well for classroom instruction and interaction and provided immediate, easily updated outreach materials for use in the classroom. I have incorporated several content areas initially developed for use during the workshops into my own teaching materials.

Lessons Learned

Several lessons were garnered from developing and presenting these agricultural workshops. First, secondary-level teachers are very interested in gaining new ways of finding instructional materials, examples, applications, and homework problems, especially in terms of reading, writing, science, and mathematics skills. Workshop participants concluded that agriculture, although a nontraditional subject for many, could indeed provide an exciting avenue because of its multidisciplinary scope and depth. Interestingly, the applications initiated by participants were as varied as the field of agriculture itself. Second, an Internet-based workshop with an interactive agenda and hands-on, Web-based activities worked well for delivering content and interactivity.

Outreach Sustainability

At the conclusion of the workshops, participants said that they desired continued access to both materials and information as the basis for incorporating various concepts into their teaching modules. The Web-based nature of the workshops made it easy to furnish materials after the sessions; the workshop pages have been indefinitely posted to the Internet and participants have the URLs.

Recommendations

Teachers and administrators concerned about curriculum development, at both the secondary and the university levels, could reap many benefits by examining agriculture. Potential dividends are new discussion materials, new sample or display materials, new examples, and even new homework and examination problems (especially story problems). Because of the breadth and the scope of agriculture, many innovative classroom materials could be developed that simultaneously address traditional issues in mathematics, science, and communication skills.

Literature Review

Agriculture encompasses a varied spectrum of disciplines and has the potential for developing educational and instructional materials. This potential is particularly extensive in science education (Dreyfus, 1986) at both the secondary and elementary levels (Trexler & Suvedi, 1998) because agriculture involves the use and modification of biological materials. Biology teachers have been among the first to infuse their curriculums with agricultural concepts (Balschweid, 2002; Jungwirth & Dreyfus, 1973). Rao and Pritchard (1984a; 1984b) provide many resources and strategies to achieve these ends. Unfortunately, the literature has not provided examples of integrating agriculture into mathematics or other scientific disciplines.

This lack of information warrants an examination of mathematics and science education in agriculture itself, which at the secondary level includes vocational education classrooms. Skills that are key elements to mathematics education in vocational agriculture curricula, include units of measurement, unit conversions, whole numbers, and applied, problem-solving methods (Miller & Vogelzang, 1983). Several resources can help fill this need; they include detailed examples and problem sets encompassing use of whole numbers (Cosler 1974c), trigonometry (Cosler, 1974b), applied mathematics (Cosler, 1974a), and problem solving (Flowers & Osborne, 1988; Osborne & Hamzah, 1989), as well as general mathematics applications (O'Connor, 1991) in agricultural settings. Other avenues include teaching economic principles (McGuire, 1966) and energy systems (Albract & French, 1980) in agricultural contexts. Further, the U.S. Census of Agriculture can be used as a raw dataset for mathematical and statistical analysis exercises (Bureau of the Census, 1987).

In addition to mathematics, scientific principles, biological and physical, have become increasingly emphasized in vocational agriculture curricula (Osborne, 1996; Sutphin, 1992). Infusing these programs with scientific knowledge and skills has been shown to improve students' understanding and scientific literacy, owing to the synergistic connections between the disciplines (Thompson, 2001; Thompson & Balschweid, 2000). Barriers to integrating science into agriculture programs center around teacher preparation time, funding limitations, and equipment constraints (Balschweid & Thompson, 2002; Balschweid et al., 2000).

Some teachers have combined mathematics and science in vocational agriculture programs. Using aquaculture as the context for integration has worked well (Conroy & Walker, 2000). Production agriculture, which has been the traditional approach to the field, has also worked well (Briers, 1986). Moreover, college-level teacher training programs are beginning to recognize the benefits of these curriculum development efforts and have even begun integrating mathematics, science, and agriculture education (Conroy & Sipple, 2001).

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Appendix

Table 24.1 Online Resources for General Descriptions of Agriculture

Sponsoring Organization	Website URL
BC Ag in the Classroom	http://www.aitc.ca/bc/pages/lessonplans/IntrotoAgriculture.html
Univ. of Saskatchewan	http://www.ag.usask.ca/exhibits/walkway/what/agric.html
Auburn University	http://www.ag.auburn.edu/agbro/whatis.htm
Eco-Motion	http://www.edisonthebus.org/ag.html
Graves Co. High School	http://gravesffa.tripod.com/gravescountyffahomepage/id10.html

Table 24.2 Online Resources for Career Options in Agriculture

Sponsoring Organization	Website URL
Auburn University	http://www.ag.auburn.edu/agbro/success.htm
BC Ag in the Classroom	http://www.aitc.ca/bc/pages/careers/careers.html
Career Clusters	http://www.careerclusters.org/ClusterDocuments/agdocuments/AGBrochure.pdf
Career Clusters	http://www.careerclusters.org/ClusterDocuments/agdocuments/1AGModel.pdf
FFA	http://www.ffa.org/careers/index.html
Graves Co. High School	http://gravesffa.tripod.com/gravescountyffahomepage/id10.html
NC State University	http://www.ag.ncat.edu/extension/programs/dte/careers.html
Top USA Jobs	http://www.topusajobs.com/jobs-by-cat/biotech/?f=google&t=biotech
Univ. of Saskatchewan	http://www.usask.ca/students/programs/fact_sheets/agriculture/ag_econ.shtml

Table 24.3 Online Resources for Agricultural History.

Sponsoring Organization	Website URL
AAHF	http://www.agri-history.org/
About, Inc.	http://inventors.about.com/library/inventors/blpotatochip.htm
About, Inc.	http://southernfood.about.com/cs/foodhistory/
About, Inc.	http://homecooking.about.com/cs/foodhistory/
Agropolis Museum	http://museum.agropolis.fr/english/default.htm
American Food Century	http://www.geocities.com/foodedge/timeline.htm
BC Ag in the Classroom	http://www.aitc.ca/bc/pages/lessonplans/TimeLine.pdf
CA Foundation Ag in Classroom	http://www.cfaitc.org/About_the_Foundation/pdf/AgAwarenessArticle.pdf
Clifford Wright	http://www.cliffordawright.com/history.html
College of Staten Island	http://www.library.csi.cuny.edu/westweb/pages/harvest.html
Cornell University	http://rmc.library.cornell.edu/food/
Food History News	http://foodhistorynews.com/
Food Museum	http://www.foodmuseum.com/
History Link	http://www.historylink101.com/history_of_farm.htm
In Depth Info	http://www.indepthinfo.com/potato/
Iowa State University	http://www.anslab.iastate.edu/Class/Ans114L/Homework/ L1%20animal%20heritage%20S03%20.ppt
IRRI	http://www.riceweb.org/
Leite's Culinaria	http://www.leitesculinaria.com/features/dining.html
Morris County Library	http://www.gti.net/mocolib1/kid/food.html
PBS	http://www.pbs.org/ktca/farmhouses/
Portable Bistro	http://portablebistro.tripod.com/foodhistory.htm
Recipe Link	http://www.allbaking.net/history.html
U.K. National Trust	http://www.nationaltrust.org.uk/environment/
University of CA, Santa Barbara	http://titicaca.ucsb.edu/cotahuasi/courses/Anth162/162d5.htm
University of Hawaii	http://www.botany.hawaii.edu/faculty/ticktin/Agriculture-class.pdf
Univ. of Houston	http://vi.uh.edu/pages/lprtomat/fdhmpg~1.htm
USDA	http://www.usda.gov/history2/back.htm

Table 24.4 Online Resources for Agricultural Production

Sponsoring Organization	Website URL
About, Inc.	http://agriculture.about.com/cs/corn1/
Arizona State University	http://nfapp.east.asu.edu/Outlook03/Value.html
Arizona State University	http://www.eas.asu.edu/~nfapp/commodities/table/usfruit1.htm
Corn Refiners Association	http://www.corn.org/
Cornell University	http://jan.mannlib.cornell.edu/reports/nassr/dairy/pmp-bb/
FAO	http://www.fao.org/
Food First	http://www.foodfirst.org
Food Production Daily	http://www.foodproductiondaily.com/
Glanbia	http://insider.glanbiausa.com/USMilkProduction.htm
ITDA	http://www.itdg.org/html/food_production/food_production.htm
N.C. State University	http://www.ces.ncsu.edu/depts/hort/greenhouse_veg/
Ohio State University	http://ohioline.osu.edu/b472/corn.html
Purdue University	http://www.hort.purdue.edu/rhodcv/hort410/genint/ge00007.htm
Sustainable Agri-Food Forum	http://www.agrifood-forum.net/home.asp
University of Idaho	http://extension.ag.uidaho.edu/blaine/ag.htm
USDA	http://www.fas.usda.gov/currwmt.html
USDA	http://www.nal.usda.gov/afsic/ofp/
USDA	http://www.usda.gov
USDA NASS	http://www.usda.gov/nass/
Washington State University	http://organic.tfrec.wsu.edu/OrganicIFP/OrganicFruitProduction/current_trends.PDF
World Hunger Year	http://www.worldhungeryear.org/

Table 24.5 Online Resources for Agricultural Processing

Sponsoring Organization	Website URL
Bio Link	http://www.bio-link.org/docs/corn.doc
FAO	http://www.fao.org/ag/aga/agap/lps/dairy/mpr/mpr.htm
FAO	http://www.fao.org/docrep/V5030E/V5030E00.htm
Food Irradiation	http://www.food-irradiation.com/basics.htm
Food Production Daily	http://www.foodproductiondaily.com/
Iowa Corn Growers	http://www.iowacorn.org/default.htm
Joint Research Center	http://www.jrc.es/projects/euromed/TEAM/FoodTecnology/ foodtechnologybackground.pdf
Meat News	http://www.meatnews.com/
Ohio State University	http://www.ingham.org/ce/HE/basicsforcanningfruit.htm
PNPPRC	http://www.pprc.org/pprc/sbap/food.html
Texas A&M University	http://aggie-horticulture.tamu.edu/syllabi/422/ppt/Cisneros1.ppt
Univ. California Davis	http://www.fruitandvegetable.ucdavis.edu/
University of Guelph	http://www.foodsci.uoguelph.ca/dairyedu/fluid.html
University of Minnesota	http://www.ddgs.umn.edu/davis-processing.pdf
University of Wisconsin	http://www.uwex.edu/ces/dairyyouth/

Table 24.6 Online Resources for Flowcharting

Sponsoring Organization	Website URL
All Clear Online	http://www.allclearonline.com/articles/effective.pdf
City Univ. of New York	http://cis.bmcc.cuny.edu/multimedia/mrc/main/tutorials/management/flowchart/home.asp
Clemson University	http://deming.eng.clemson.edu/pub/tutorials/qctools/flowm.htm
Dexter Hanson	http://home.att.net/~dexter.a.hansen/flowchart/flowchart.htm
Six Sigma	http://www.isixsigma.com/offsite.asp?A=Fr&Url=http://quality.disa.mil/pdf/flowchrt.pdf
Six Sigma	http://www.isixsigma.com/offsite.asp?A=Fr&Url=http://www.sytsma.com/tqmtools/flow.html
Smart Draw	http://www.smartdraw.com/specials/flowchart.asp
Studio 1151	http://www.mcli.dist.maricopa.edu/authoring/studio/guidebook/flow.html

Table 24.7 Online Resources for Modeling and Simulation

Sponsoring Organization	Website URL
U.S. Army	http://www.amso.army.mil/harmon/
Concordia University	http://www.cuaa.edu/computing/softrain/excel/excel08.shtml
Duke University	http://faculty.fuqua.duke.edu/~pecklund/ExcelReview/2001_Documents/2001SvelteStepByStep.pdf
Ohio Supercomputer Center	http://www.osc.edu/education/webed/Projects/model_and_statistics/

Table 24.8 Online Resources for Biotechnology

Sponsoring Organization	Website URL
Ag Biotech Net	http://www.agbiotechnet.com/Directory/az_detail.asp?lett=A
BioFirst	http://www.biofirst.nsw.gov.au/applications/agriculture.asp
Biotech Industry Organization	http://www.bio.org/
Biotech Industry Organization	http://www.bio.org/foodag/
Biotech Market	http://www.biotec-market.com/
Cato Research	http://www.cato.com/biotech/index.html
CBI	http://www.whybiotech.com/
CGIAR	http://www.cgiar.org/biotech/rep0100/contents.htm
Dept. of Ag, Australia	http://www.affa.gov.au/content/output.cfm?&CONTTYPE=outputs&OBJECTID=5A53B336-FC4E-411E-8C06A9D82C6AE0C9
FDA	http://vm.cfsan.fda.gov/~lrd/biotechm.html
MI State Univ.	http://www.iia.msu.edu/absp/
Monsanto Co.	http://www.monsanto.com/monsanto/layout/default.asp
Monsanto Co., UK	http://www.monsanto.co.uk/
Rutgers State University	http://www.nalusda.gov/bic/Pubpercep/
Strategis	http://strategis.ic.gc.ca/SSG/bo01376e.html
Strategis	http://strategis.ic.gc.ca/SSG/bo01410e.html
Texas A&M Univ.	http://agbiotech.tamu.edu/ag_bio_teks.html
Univ. Nebraska	http://agbiosafety.unl.edu/education.shtml
USDA	http://www.usda.gov/agencies/biotech/
USDA	http://www.nal.usda.gov/bic/
Yahoo	http://dir.yahoo.com/Science/Agriculture/Biotechnology/

Table 24.9 Online Resources for Geographic Information Systems.

Sponsoring Organization	Website URL
California State Univ.	http://www.precisionag.org/
Cranfield Univ.	http://www.silsoe.cranfield.ac.uk/cpf/
Farm Scan	http://www.farmscan.net/home.aspx
Iowa State Univ.	http://www.abe.iastat e.edu/GISLAB/gis_lab.html
Iowa State Univ.	http://www.abe.iastate.edu/GISLAB/html/project5.htm
Kansas State Univ.	http://www.oznet.ksu.edu/precisionag/
NASA	http://www.ghcc.msfc.nasa.gov/precisionag/precisionag.html
NC State University	http://www.bae.ncsu.edu/programs/extension/agmachine/precision/
Precision Ag	http://www.precisionag.com/
Texas A&M Univ.	http://txprecag.tamu.edu/
Texas S&M Univ.	http://precisionagriculture.tamu.edu/
Trimble	http://www.trimble.com/agriculture.html
Univ. of Minnesota	http://precision.agri.umn.edu/
Univ. of MO-Columbia	http://www.fse.missouri.edu/mpac/
Univ. of Sydney	http://www.usyd.edu.au/su/agric/acpa/
ESRI	http://www.esri.com/gisforeveryone/basics/
GIS Lounge	http://www.gislounge.com/
State Univ. New York	http://www.geog.buffalo.edu/ncgia/gishist/
Univ. of California	http://gis.ucsc.edu/
Univ. of Edinburgh	http://www.geo.ed.ac.uk/agidict/welcome.html
USGS	http://info.er.usgs.gov/research/gis/title.html
Utah State Univ.	http://www.gis.usu.edu/

Table 24.10 Online Resources for Incorporating Agriculture into Classrooms

Sponsoring Organization	Website URL
Ag in the Classroom	http://www.agclassroom.org/
Ag in the Classroom	http://www.agclassroom.org/teacher/lessons.htm
BC Ag in Classroom	http://www.aitc.ca/
BC Ag in Classroom	http://www.aitc.ca/bc/pages/lessonplans/IntrotoAgriculture.html
Career Clusters	http://www.careerclusters.org/ClusterDocuments/agdocuments/AGFinal.pdf
FFA	http://www.ffa.org/programs/lps/html/practicesindex.html
IL Farm Bureau	http://www.agintheclassroom.org/resources/resources.htm
Illinois Area III	http://www.lth3.k12.il.us/K-2/farm/farmunit.pdf
Industry Canada	http://collections.ic.gc.ca/agriculture/top.htm
MI Farm Bureau	http://www.michiganfarmbureau.com/education/aitc.php
NC State University	http://www.cals.ncsu.edu:8050/agexed/sae/toolbox/
OR State University	http://aitc.orst.edu/
SCFA	http://www.scforestry.org/teachers.html
Space Ag in the Classroom	http://www.spaceag.org
WA Ag in Classroom	http://www.waic.net/
Walnut Grove H.S.	http://www.mda.state.mo.us/pdf/AgLitContest20024th.pdf
WI Dairy Council	http://www.dcwnet.org/index_flash.html