

# Conversion Factors for SI and non-SI Units

To convert Column 1 into Column 2, multiply by	Column 1 SI Unit	Column 2 non-SI Unit	To convert Column 2 into Column 1, multiply by
<b>Length</b>			
0.621	kilometer, km ( $10^3$ m)	mile, mi	1.609
1.094	meter, m	yard, yd	0.914
3.28	meter, m	foot, ft	0.304
1.0	micrometer, $\mu\text{m}$ ( $10^{-6}$ m)	micron, $\mu$	1.0
$3.94 \times 10^{-2}$	millimeter, mm ( $10^{-3}$ m)	inch, in	25.4
10	nanometer, nm ( $10^{-9}$ m)	Angstrom, $\text{\AA}$	0.1
<b>Area</b>			
2.47	hectare, ha	acre	0.405
247	square kilometer, $\text{km}^2$ ( $10^3$ m) <sup>2</sup>	acre	$4.05 \times 10^{-3}$
0.386	square kilometer, $\text{km}^2$ ( $10^3$ m) <sup>2</sup>	square mile, $\text{mi}^2$	2.590
$2.47 \times 10^{-4}$	square meter, $\text{m}^2$	acre	$4.05 \times 10^3$
10.76	square meter, $\text{m}^2$	square foot, $\text{ft}^2$	$9.29 \times 10^{-2}$
$1.55 \times 10^{-3}$	square millimeter, $\text{mm}^2$ ( $10^{-3}$ m) <sup>2</sup>	square inch, $\text{in}^2$	645
<b>Volume</b>			
$9.73 \times 10^{-3}$	cubic meter, $\text{m}^3$	acre-inch	102.8
35.3	cubic meter, $\text{m}^3$	cubic foot, $\text{ft}^3$	$2.83 \times 10^{-2}$
$6.10 \times 10^4$	cubic meter, $\text{m}^3$	cubic inch, $\text{in}^3$	$1.64 \times 10^{-5}$
$2.84 \times 10^{-2}$	liter, L ( $10^{-3}$ m <sup>3</sup> )	bushel, bu	35.24
1.057	liter, L ( $10^{-3}$ m <sup>3</sup> )	quart (liquid), qt	0.946
$3.53 \times 10^{-2}$	liter, L ( $10^{-3}$ m <sup>3</sup> )	cubic foot, $\text{ft}^3$	28.3
0.265	liter, L ( $10^{-3}$ m <sup>3</sup> )	gallon	3.78
33.78	liter, L ( $10^{-3}$ m <sup>3</sup> )	ounce (fluid), oz	$2.96 \times 10^{-2}$
2.11	liter, L ( $10^{-3}$ m <sup>3</sup> )	pint (fluid), pt	0.473
<b>Mass</b>			
$2.20 \times 10^{-3}$	gram, g ( $10^{-3}$ kg)	pound, lb	454
$3.52 \times 10^{-2}$	gram, g ( $10^{-3}$ kg)	ounce (avdp), oz	28.4
2.205	kilogram, kg	pound, lb	0.454
0.01	kilogram, kg	quintal (metric), q	100
$1.10 \times 10^{-3}$	kilogram, kg	ton (2000 lb), ton	907
1.102	megagram, Mg (tonne)	ton (U.S.), ton	0.907
1.102	tonne, t	ton (U.S.), ton	0.907
<b>Yield and Rate</b>			
0.893	kilogram per hectare, $\text{kg ha}^{-1}$	pound per acre, $\text{lb acre}^{-1}$	1.12
$7.77 \times 10^{-2}$	kilogram per cubic meter, $\text{kg m}^{-3}$	pound per bushel, $\text{bu}^{-1}$	12.87
$1.49 \times 10^{-2}$	kilogram per hectare, $\text{kg ha}^{-1}$	bushel per acre, 60 lb	67.19
$1.59 \times 10^{-2}$	kilogram per hectare, $\text{kg ha}^{-1}$	bushel per acre, 56 lb	62.71
$1.86 \times 10^{-2}$	kilogram per hectare, $\text{kg ha}^{-1}$	bushel per acre, 48 lb	53.75
0.107	liter per hectare, $\text{L ha}^{-1}$	gallon per acre	9.35
893	tonnes per hectare, $\text{t ha}^{-1}$	pound per acre, $\text{lb acre}^{-1}$	$1.12 \times 10^{-3}$
893	megagram per hectare, $\text{Mg ha}^{-1}$	pound per acre, $\text{lb acre}^{-1}$	$1.12 \times 10^{-3}$
0.446	megagram per hectare, $\text{Mg ha}^{-1}$	ton (2000 lb) per acre, $\text{ton acre}^{-1}$	2.24
2.24	meter per second, $\text{m s}^{-1}$	mile per hour	0.447
<b>Specific Surface</b>			
10	square meter per kilogram, $\text{m}^2 \text{kg}^{-1}$	square centimeter per gram, $\text{cm}^2 \text{g}^{-1}$	0.1
1000	square meter per kilogram, $\text{m}^2 \text{kg}^{-1}$	square millimeter per gram, $\text{mm}^2 \text{g}^{-1}$	0.001
<b>Pressure</b>			
9.90	megapascal, MPa ( $10^6$ Pa)	atmosphere	0.101
10	megapascal, MPa ( $10^6$ Pa)	bar	0.1
1.00	megagram per cubic meter, $\text{Mg m}^{-3}$	gram per cubic centimeter, $\text{g cm}^{-3}$	1.00
$2.09 \times 10^{-2}$	pascal, Pa	pound per square foot, $\text{lb ft}^{-2}$	47.9
$1.45 \times 10^{-4}$	pascal, Pa	pound per square inch, $\text{lb in}^{-2}$	$6.90 \times 10^3$

(continued on next page)

# Conversion Factors for SI and non-SI Units

To convert Column 1 into Column 2, multiply by	Column 1 SI Unit	Column 2 non-SI Unit	To convert Column 2 into Column 1, multiply by
<b>Temperature</b>			
1.00 (K - 273) (9/5 °C) + 32	Kelvin, K Celsius, °C	Celsius, °C Fahrenheit, °F	1.00 (°C + 273) 5/9 (°F - 32)
<b>Energy, Work, Quantity of Heat</b>			
9.52 × 10 <sup>-4</sup> 0.239 10 <sup>7</sup> 0.735 2.387 × 10 <sup>-5</sup> 10 <sup>5</sup> 1.43 × 10 <sup>-3</sup>	joule, J joule, J joule, J joule, J joule per square meter, J m <sup>-2</sup> newton, N watt per square meter, W m <sup>-2</sup>	British thermal unit, Btu calorie, cal erg foot-pound calorie per square centimeter (langley) dyne calorie per square centimeter minute (irradiance), cal cm <sup>-2</sup> min <sup>-1</sup>	1.05 × 10 <sup>3</sup> 4.19 10 <sup>-7</sup> 1.36 4.19 × 10 <sup>4</sup> 10 <sup>-5</sup> 698
<b>Transpiration and Photosynthesis</b>			
3.60 × 10 <sup>-2</sup> 5.56 × 10 <sup>-3</sup> 10 <sup>-4</sup> 35.97	milligram per square meter second, mg m <sup>-2</sup> s <sup>-1</sup> milligram (H <sub>2</sub> O) per square meter second, mg m <sup>-2</sup> s <sup>-1</sup> milligram per square meter second, mg m <sup>-2</sup> s <sup>-1</sup> milligram per square meter second, mg m <sup>-2</sup> s <sup>-1</sup>	gram per square decimeter hour, g dm <sup>-2</sup> h <sup>-1</sup> micromole (H <sub>2</sub> O) per square centi- meter second, μmol cm <sup>-2</sup> s <sup>-1</sup> milligram per square centimeter second, mg cm <sup>-2</sup> s <sup>-1</sup> milligram per square decimeter hour, mg dm <sup>-2</sup> h <sup>-1</sup>	27.8 180 10 <sup>4</sup> 2.78 × 10 <sup>-2</sup>
<b>Plane Angle</b>			
57.3	radian, rad	degrees (angle), °	1.75 × 10 <sup>-2</sup>
<b>Electrical Conductivity, Electricity, and Magnetism</b>			
10 10 <sup>4</sup>	siemen per meter, S m <sup>-1</sup> tesla, T	millimho per centimeter, mmho cm <sup>-1</sup> gauss, G	0.1 10 <sup>-4</sup>
<b>Water Measurement</b>			
9.73 × 10 <sup>-3</sup> 9.81 × 10 <sup>-3</sup> 4.40 8.11 97.28 8.1 × 10 <sup>-2</sup>	cubic meter, m <sup>3</sup> cubic meter per hour, m <sup>3</sup> h <sup>-1</sup> cubic meter per hour, m <sup>3</sup> h <sup>-1</sup> hectare-meters, ha-m hectare-meters, ha-m hectare-centimeters, ha-cm	acre-inches, acre-in cubic feet per second, ft <sup>3</sup> s <sup>-1</sup> U.S. gallons per minute, gal min <sup>-1</sup> acre-feet, acre-ft acre-inches, acre-in acre-feet, acre-ft	102.8 101.9 0.227 0.123 1.03 × 10 <sup>-2</sup> 12.33
<b>Concentrations</b>			
1 0.1 1	centimole per kilogram, cmol kg <sup>-1</sup> gram per kilogram, g kg <sup>-1</sup> milligram per kilogram, mg kg <sup>-1</sup>	milliequivalents per 100 grams, meq 100 g <sup>-1</sup> percent, % parts per million, ppm	1 10 1
<b>Radioactivity</b>			
2.7 × 10 <sup>-11</sup> 2.7 × 10 <sup>-2</sup> 100 100	becquerel, Bq becquerel per kilogram, Bq kg <sup>-1</sup> gray, Gy (absorbed dose) sievert, Sv (equivalent dose)	curie, Ci picocurie per gram, pCi g <sup>-1</sup> rad, rd rem (roentgen equivalent man)	3.7 × 10 <sup>10</sup> 37 0.01 0.01
<b>Plant Nutrient Conversion</b>			
	<i>Elemental</i>	<i>Oxide</i>	
2.29 1.20 1.39 1.66	P K Ca Mg	P <sub>2</sub> O <sub>5</sub> K <sub>2</sub> O CaO MgO	0.437 0.830 0.715 0.602

# Contributions Accepted by *Journal of Natural Resources and Life Sciences Education*

## Letters to the Editor

Comments concerning editorials, manuscripts, or other printed materials in recent issues of the journal, if approved for publication, will be printed without page charges. Send your letters to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Notes

These contributions may include instructional techniques, computer software descriptions, slide set articles, or any study that contributes to the development or better understanding of resident, extension, or industrial education. You need not have several years of research data to support your thoughts; your note can be based mainly upon personal philosophies or opinions. Although there are no page limitations on notes, brevity is recommended. Send notes (five complete copies) to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Regular Manuscripts

Most authors, despite the broad range of contributions being accepted by the journal, still prefer to report on classroom studies. These include student opinion surveys, experiences that have evolved through the years, comparisons of teaching techniques, and other instructional methodology that merits multiple research data support. Review articles, computer software articles, slide set articles, and case studies are also published as regular manuscripts. Submit five copies of regular manuscripts to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Computer Software Articles

As a natural consequence of increased computerization in the classroom, authors are submitting greater numbers of articles describing computer software. Authors should see *J. Agron. Educ.* 14:51 for more information. Send five copies of your contribution to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Slide Set Articles

The goal of slide-set publications is to encourage development and distribution of slide-sets for instruction. The specific objectives are to (a) give publication credit to the author, (b) describe a 2 × 2 slide-set for teaching or other purposes, and (c) relate its availability to the reader who may choose to use it. Slide-set publications are of significant value to readers and of professional advantage to the authors and the journal. For more information on the slide set publication policy, see *J. Nat. Resour. Life Sci. Educ.* 22:10. Send five copies of your slide set article directly to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Case Study Articles

Interest in providing problem-solving and decision-making experiences in education has sparked interest in the adaptation of decision cases for publication in this journal. Although decision cases have long been used in colleges of business, they have only recently been adapted to natural resources, life sciences, and agriculture. Guidelines have been developed to describe the format for publication of decision cases in the *Journal of Natural Resources and Life Sciences Education*. Prospective authors will find it helpful to see *J. Nat. Resour. Life Sci. Educ.* 21:2-3 for guidelines in manuscript preparation to ensure minimum editorial delay. Send five copies of your case study article to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Profiles

The educational contributions of many noted educators have been included in past issues of the journal. Manuscripts concerning colleagues who have become noted in the field of education are welcomed. If accepted for publication, page charges will be waived. Please contact Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080), prior to writing your profile for information on format and possible publication dates.

## Media Reviews

Textbooks, software, videotapes, or other media that may have merit for undergraduate or graduate classroom usage are periodically reviewed by members of the Society who volunteer their services. If you wish to review media, contact Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Ideas and Issues

Any tips for incorporating systems approaches to teaching into your courses? Any hints for ensuring that students read their textbook assignments? Any good techniques for handling makeup exams? Any advising tips? The journal accepts contributions concerning ideas that do not warrant full-length manuscripts or notes. The "Ideas and Issues" section is a forum for opinions, reports, issues, and ideas in teaching and extension. These are limited to one or two paragraphs. Page charges for Ideas and Issues are minimal due to length limitation. Send your contribution directly to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Newsfeatures

The Newsfeatures section in the journal presents practices or ideas of interest to readers. The items differ from regular articles in that they are of limited scope and cover events too recent for full documentation. The Editor approves Newsfeatures. Send your contributions to Susan Ernst, Managing Editor, 677 South Segoe Road, Madison, WI 53711 (608-273-8080).

## Suggestions for Contributors to *Journal of Natural Resources and Life Sciences Education*

**Scope of Contributions.** The Editorial Board will review: (1) reports of original research pertaining to concepts of resident, extension, and industrial education; (2) analyses and syntheses of existing knowledge or research, instructional techniques and methodology, surveys of instruction, and other studies that contribute to the development or better understanding of educational efforts; (3) reviews or digests of a comprehensive and well-defined scope; (4) case studies (*see* J. Nat. Resour. Life Sci. Educ. 21:2-3); (5) short communications and letters to the editor; (6) slide set articles; (7) newsfeatures; and (8) ideas and issues. Articles may confirm and strengthen the findings of others, revise established ideas or practices, or challenge accepted theory, providing the evidence presented is significant and convincing. Manuscripts based chiefly on personal philosophy or opinion are acceptable if they conform to the above criteria. The editor solicits media reviews (including books, videos, films, slide sets, and computer software) and profiles, or they may be volunteered. The Editorial Board will also consider slide sets (*see* J. Agron. Educ. 9:85) and computer software papers (*see* J. Agron. Educ. 14(1):51). The journal encourages "Letters to the Editor," including comments and criticisms of published articles and editorials, suggestions for journal improvement, and other educational concerns or viewpoints.

**Page Charges.** Page charges are assessed as follows: \$45/page for the first four pages; \$165 for each additional page over four pages (\$83/half page). Authors may be charged for the cost of illustrations or tables beyond \$15 for each contribution. Authors may purchase reprints of their articles.

**Prior Publication.** Manuscripts published in *Journal of Natural Resources and Life Sciences Education* must be original reports. They may not have been published previously or simultaneously submitted to another scientific or technical journal. In general, publication in nontechnical media will be considered prior publication only when all of the data and conclusions are included in the nontechnical medium.

**Manuscript Preparation.** Manuscripts must conform to the requirements set forth in the *ASA Publications Handbook and Style Manual*. Copies of the style manual are available at the mailing address, above. Type the manuscript double-spaced on good grade bond paper, approximately 21 × 28 cm. *The lines of type must be numbered on each page. Submit five copies, all on line-numbered paper.* Type each table on a separate sheet and type captions for tables and figures together on one sheet (more as needed) and place at the end of the manuscript. Include an abstract at the beginning of the manuscript.

**Author/Paper Documentation.** Include this documentation at the bottom of the title page. It lists author(s) and complete address(es) first, sponsoring organization(s) with incomplete address(es) second, and date received last (added by Headquarters). Identify the corresponding author and person from whom reprints should be requested with an asterisk(\*). Professional titles will not be listed. Other information, such as grant funding, may be included before the date received in the documentation or in the acknowledgment at the end of the article.

**Tables.** Number tables consecutively. Use the following symbols for footnotes, in this order: †, ‡, §, ¶, #, ††, etc. To indicate statistical significance, \* and \*\* have priority in this order to show 5 and 1% levels of significance.

**Figures.** Provide photographs for halftone reproduction as glossy prints with good dark and light contrast. Prepare drawings for graphs and charts with dark, heavy lines for quality reduction and printing.

So far as possible, use photographs and drawings that can be reduced to a 1-column width (8.4 cm). A good size for a

drawing is twice that desired in the printed figure. Lettering or numbers in a printed figure should not be smaller than the type size in the body of an article as printed in journal or larger than the size of the main subheads. Label each figure with name of author, title of article, and number of figure. Original figures and photographs will not be returned to authors unless we are notified in writing to do so.

**Official Sources.** The journal uses the following as sources of editorial style:

1. General style: *ASA Publications Handbook and Style Manual* (ASA, CSSA, SSSA) and the *CBE Style Manual* (Council of Biology Editors)
2. Spelling: *Webster's New Collegiate Dictionary*
3. Scientific names of plants: *A Checklist of Names for 3000 Vascular Plants of Economic Importance* (USDA Agric. Handb. 505)
4. Chemical names of pesticides: *Farm Chemicals Handbook* (Meister Publishing)
5. Soil series names: *Soil Series of the United States, Including Puerto Rico and the U.S. Virgin Islands* (USDA-SCS Misc. Publ. 1483)
6. Fungal nomenclature: *Fungi on Plants and Plant Products in the United States* (APS Press)
7. Journal abbreviations: *Chemical Abstracts Service Source Index* (American Chemical Society)

**Abbreviations.** Standard abbreviations listed in the *CBE Style Manual* (5th ed., 1983) and the *Publications Handbook and Style Manual* may be used without definition. Authors shall provide one footnote that contains abbreviations for all words or terms used in the manuscript for which there are no abbreviations given in the ASA or CBE style manuals.

**Nomenclature.** Show the Latin binomial or trinomial and authority for all plants, insects, and pathogens at first listing in the abstract and manuscript. Identify crop cultivars (not experimental lines and strains) by single quotation marks at first listing only; e.g., 'Ranger' alfalfa (*Medicago sativa* L.) or *Medicago sativa* L. 'Ranger'.

**Units of Measure.** Use SI units for all measurements. Report all yields of crops in units of weight or mass. Exceptions may be allowed by the editor.

**References.** List all citations to published literature alphabetically by senior authors at the end of the manuscript. Citations should include names of all authors, the year, complete title, publication, volume number, and inclusive pages, as appropriate.

Reference lists may include Agronomy Abstracts, theses, and dissertations. If available, the publication number or dissertation abstract number should be given. Unpublished data, personal communications, and unavailable mimeo reports may be included in the text in parentheses.

**Length of Manuscript.** About four pages of manuscript will usually equal one printed page. Space for figures and tables must be estimated separately.

**Format.** The usual format of an article is: (1) Title and author(s), (2) Author/paper documentation, (3) Abstract, (4) Introduction and review, (5) Body, (6) References, (7) Tables, and (8) Figures.

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Manuscripts (five copies) should be sent to:

Managing Editor, *Journal of Natural Resources and Life Sciences Education*, American Society of Agronomy, 677 South Segoe Road, Madison, WI 53711.

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## NEWSFEATURES

### Microbiology Workshop

Kansas State University is planning the 15th GALA Anniversary International Workshop on Rapid Methods and Automation in Microbiology.

In the past 14 years, this series has attracted more than 1000 scientists from 40 states and 30 countries to Manhattan, KS, to spend eight days in working with the cutting edge of microbial technologies and interacting with outstanding, internationally known scientists.

The workshop is from 7 to 14 July 1995 and the symposium is from 7 to 8 July 1995. For more information, contact Daniel Y.C. Fung, Workshop Director, 225 Call Hall, Kansas State University, Manhattan, KS 66506; phone (913) 532-5654, fax (913) 532-5681. ■

### BIOSIS Launches Multidisciplinary Genetics Database on Compact Disc

On 18 Oct. 1994 in Philadelphia, PA, BIOSIS, the world's largest abstracting and indexing service for the life sciences, announced the latest addition to its CD-ROM product line, *BIOSIS GenRef on Compact Disc*. A unique database on genetics, it became available to users in the first quarter of 1995.

*BIOSIS GenRef on Compact Disc* offers comprehensive, multidisciplinary coverage of genetics literature that is vital to the research of many life scientists. Records are selected from 6500 scientific journals, 340 business publications, and the proceedings of 2000 international meetings. International gene sequence numbers are added whenever they appear in the original article. Using these sequence numbers, researchers can find data from the three

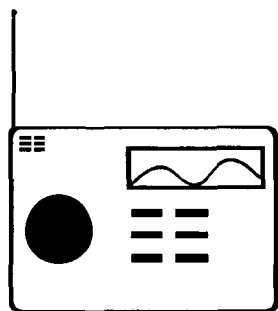
international genetic repositories: GenBank, the European Molecular Biology Laboratory (EMBL), and the DNA Data Bank of Japan (DDBJ).

*BIOSIS GenRef on Compact Disc* is easy to use for both the experienced and the novice searcher. This state-of-the-art search software is available on DOS and Windows.

For more information, contact Irene D. Jacobs, BIOSIS, Marketing and Sales, 2100 Arch Street, Philadelphia, PA 19103-1399; phone (800) 523-4806 USA and Canada; and (215) 587-4847 worldwide. ■

Instructions for simple, at-home experiments are featured, providing listeners with a hands-on activity to reinforce learning. A toll-free number for the program encourages the children to call and discuss the results of their experiment. Selected calls will be incorporated into the future episodes of *Kinetic City Super Crew*.

The program is being offered to radio stations in the USA that target children and young adults as their primary audience, and stations with a significant element of children's programming. For more information, call Ellen Cooper at (202) 326-6431. ■



### Teach Science via Radio

Following last year's successful debut as a pilot program, the American Association for the Advancement of Science (AAAS) children's radio adventure—the *Kinetic City Super Crew*—flourished when the first of more than 90 new episodes reached the airwaves last fall, thanks to a recent \$3 million grant from the National Science Foundation.

The program, which emulates radio dramas of the past to teach children about science and technology, aims to capture the imagination of third, fourth, and fifth grade students through the intrigue of mystery and the mastery of problem-solving. The new episodes will strive to repeat the success of the four pilot shows, which received favorable responses from young listeners, particularly girls and minorities.

### FLP Receives National Funding

The U.S. Environmental Protection Agency (USEPA), Office of Environmental Education recently chose Project Food, Land & People (FLP) to assist with its mission of increasing public understanding of the natural environment and advancing conservation education and training. Project Food, Land & People was selected from 324 applicants at the national level, placing it among the top 4% of applicants! The grant award provides FLP with \$35,000 of federal financial support to match FLP's in-kind contribution of \$15,000.

The USEPA grant will help disseminate FLP's curricula through innovative training workshops designed to make educators more aware of the critically important interconnections between humans, agriculture, and land and water resources. The grant also supports translating 10 FLP lessons into Spanish to provide needed materials to Spanish-speaking students and educators.

With assistance of the USEPA funds, FLP anticipates an accelerated movement forward in the incorporation of its program

into formal (classroom) and informal (youth development program) settings. Grant-funded activities coordinate the incorporation of FLP's program, including its learning resources and innovative whole-system training approach to agricultural and conservation education, into grades K-12. It will encourage and enable individuals to become personally motivated and capable of making informed choices as consumers and citizens. FLP complements and enriches existing K-12 grade efforts in conservation education.

Reprinted in part with permission from FLP. For more information, contact Chris Williams, FLP Chair, 179 West Kent Dr., Chandler, AZ 85224; phone (602) 786-9969. ■

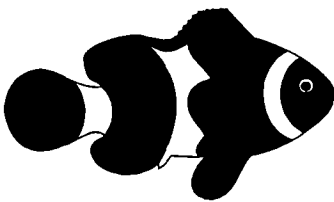
### **New Manual Provides Activity-Based Lessons in Bottle Biology**

*Using Fast Plants & Bottle Biology in the Classroom* is a valuable new aid for teachers integrating agriculture education into current high school biology programs. The 12 activity-based lessons use Bottle Biology and Wisconsin Fast Plants to investigate a variety of topics including gravitropism, water quality, microbial fermentation, acid rain, salinization, and nitrogen leaching.

Bottle Biology offers an inexpensive and imaginative way to teach biology using throw-away plastic containers. Wisconsin Fast Plants are a variety of rapidly cycling *Brassica rapa*, ideally suited for short semesters and limited space. Detailed descriptions of Bottle Biology and Wisconsin Fast Plants are provided in the manual. Background information, preparation, activity time, and guidance materials for teachers in addition to student instructions, questions, and data sheets are provided for each lesson.

Published by the National Association of Biology Teachers, the manual was developed by 40 high school agriculture and biology teachers at two AgriScience Institutes at the University of Wisconsin-Madison in conjunction with the University of California-Davis. Funded by the W.K. Kellogg Foundation, the publication is a special project of the National Council for Agriculture Education through the National Future Farmers of America Foundation.

The 264-page manual is available through the National Association of Biology Teachers for \$24, including shipping and handling. To order, contact NABT, 11250 Roger Bacon Dr., Reston, VA 22090; (703) 471-1134. ■



### **New National Resource for Marine Biotechnology and Science Education**

How can marine biotechnology lead to increased seafood harvests, strategies for environmental preservation, and new products such as nontoxic paints and adhesives? How can the public's discovery of all these scientific wonders become a powerful tool for engaging a future work force?

The answers can be found at the Columbus Center, Baltimore, MD, a unique institution dedicated to furthering research, public literacy in science, education, and economic development. Scientists will move into the \$160 million Columbus Center, now under construction at Baltimore's Inner Harbor, in February of 1995 to start their work. The center will open to the public in the spring of 1996, offering a one-of-a-kind integration of research with public outreach.

The Columbus Center is a new national center for marine biotechnology research. It will attract a critical mass of researchers in marine biotechnology, a largely unexplored frontier of science with the potential to shape the quality of life in the next century. In the USA and worldwide, investigation of the oceans' resources has an increasingly valuable economic and environmental impact.

Marine biotechnology already focuses on the essentially unexplored profusion of life in the oceans and uses nature's basic building blocks to generate practical, and potentially profitable, discoveries. Scientists are already working on applications that include new pharmaceuticals, increasing seafood production, engineering microbes to remove environmental contaminants, and developing new industrial products of commercial value. For the first time, a major concentration of marine biotechnologists will begin the task of cataloging the vast biological diversity of the oceans at the molecular level.

The center is comprised of four major components: the Center of Marine Biotechnology, the Center of Maritime Archaeology, the Hall of Exploration, and the Science and Technology Education Center.

For more information, contact Cheryl G. Hudgins; phone (410) 547-8727. ■

### **Master of Science Program in Ecological Agriculture**

The Wageningen Agricultural University, the Netherlands, organizes a M.S. program in ecological agriculture with a duration of 17 mo (starting every September). In the first year, participants study advanced courses in ecological agriculture such as phenomenology, design and analysis of mixed farming systems, system analysis in agriculture, and socio-economic aspects of ecological agriculture. The program is flexible; participants are asked to compose their own study programs.

The advanced courses are a preparation on the thesis research. To get the M.S. degree, students must finish with a 6-mo research project resulting in a thesis. The subject of the thesis is determined in consultation with the course staff.

Applicants must have a B.S. degree in agriculture (or other relevant subject), a proven knowledge of the English language, and a well-described thesis subject. The costs are around Dfl 40,000 (about \$20,000 U.S.), including fees, housing, food, books, etc.

For more information, write to Department of Ecological Agriculture, Ir. C. van Veluw, Haarweg 333, 6709 RZ Wageningen, the Netherlands; phone 31-8370-84676/83522, fax 31-8370-84575. ■

### **Cultivate Minority Student Environmental Science Interest**

An innovative cooperative education program between California State University, Los Angeles (CSULA) and the USEPA's Environmental Research Laboratory-Corvallis (ERL-C) is attracting promising minority students to careers in environmental science and helping them hone their skills through hands-on participation in actual research programs.

Now in its third year, the program supports selected students during the regular school year with work in CSULA's Biology Department lab. During the summer months, participants engage in internships at ERL-C where they are involved with programs focused on ozone effects, global processes, ecosystem studies, and related activities.

The program was cooperatively developed between ERL-C and CSULA, identified as "the most culturally diverse campus in the country" according to a 1991 statement by T.J. Crovelo, CSULA's

Dean of Graduate Studies and Research. Of its 21,000 students, approximately 35% are Hispanic, 30% Asian, 25% white, and 10% black.

The USEPA project officer for the program, G. Neely, commented on the positive outcome for not only the students, but Cal State and ERL-C. "All parties involved are benefitting from this agreement. ERL-C has gained much needed assistance, students have had a first-hand opportunity to work in a state-of-the-art research program, and the Cal State Biology program has been able to expand development of its environmental research studies curriculum," he said.

For more information from ERL-C, contact: G. Neely, e-mail <grady@heart.cor.epa.gov>; phone (503) 754-4684. ■



## Raindrops Keep Falling on Our Heads

Did you know that the raindrops falling on our heads today could be the same water that splattered the noggins of dinosaurs millions of years ago? Once you and your kids understand that the water we use is the same water that has been in use since the beginning of time, you'll treat it differently.

A clean water packet for you and your family is available free of charge from the Soil Conservation Service, an agency of the USDA and from the Soil and Water Conservation Society, an independent, non-profit, international organization. The packet explains the water cycle through:

1. Two beautiful, colored posters
2. A cartoon booklet for kids
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To order the packet, call (800) THE-SOIL (800/843-7645). ■

## Vocational Education Here and Abroad

For many students, vocational education is an important route to assuring success. Information on the condition of vocational education in the U.S. and other countries is now available in two new Office of Educational Research and Improvement (OERI) reports that will inform the debate on how federal education dollars can best be used to prepare students for a highly competitive workforce.

The National Assessment of Vocational Education (NAVE), in a five-volume final report, argues that both vocational and general track education programs must improve substantially to prepare students for more education or for high-skill, high-wage jobs. The study was developed over the past 3 years under the guidance of a 17-member independent advisory panel.

Order the reports from GPO. You may order the full five-volume *National Assessment of Vocational Education: Final Report to Congress* (stock no. 065-000-00692-8; call GPO Order Desk for price). Volume I, *Summary and Recommendations* (stock no. 065-000-00685-5, \$4.75) is available separately. *Vocational Education in G-7 Countries: Profiles and Data* is \$9 (stock no. 065-000-00688-0). Available from Government Printing Office, Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. Order Desk: (202) 512-1800. You may fax credit card orders to (202) 512-2250. ■

## Fun With the Plant Nutrition Team

Primary grade children ask lots of questions: How do plants grow? What's in dirt? What happens to plants if they do not have water or sunlight?

A new activity book helps teachers answer some of those questions. Developed by the Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR) for students in kindergarten through third grade, the teaching kit presents information about the importance of plant nutrients and basic concepts of food and fiber production.

"Fun With the Plant Nutrient Team" is a 24-page booklet introducing young children to nitrogen, phosphorus, and potassium, the major plant nutrients. They appear as cartoon characters in a variety of activities designed especially for primary grades: dot-to-dot, word puzzles, coloring activities, mazes, matching pictures, and experiments. The activities also present

basic scientific principles, including soil conservation and the importance of modern science to today's farmers. The teacher's guide helps teachers incorporate the activity book into a variety of hands-on lessons. The guide also includes scientific data that helps teachers understand the background of the information presented in the activity book.

Copies of the student activity book are \$1.00 each, plus shipping and handling. For more information, contact PPI, Circulation Manager, 655 Engineering Drive, Suite 110, Norcross, GA 30092-2821; phone (404) 447-0335.

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Kits are available for grades K-1, 2-3, and 4-5. All encourage thematic teaching, and all help teachers incorporate lessons with a mum theme into science, math, reading, social studies, language arts, art, environmental studies, and fitness.

The Teacher's Guide includes suggestions for hands-on experiments, plant growing projects, spring and fall mum festivals, and beautification activities for the school and the community. The accompanying kit includes a garden mum poster, a history of chrysanthemums, 60 stickers featuring cartoon characters known as the Mum Kids, a resource list of books and magazines, and 50 push-on tags containing growing tips and a photo. Also included is ordering information for a free Classroom

Chrysanthemum Cutting Kit providing enough plant cuttings to grow 50 plants.

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## On-Line Link Helps Teachers Share Math, Science Teaching Tools

Have you ever wished that you could share your innovative ideas with teachers throughout the nation? Have you ever wanted the opportunity to ask other teachers how they teach a particular mathematics or science concept? Have you ever needed materials for a math or science lesson and been unable to find something useful? Have you ever wondered where to begin to look for these materials?

Teachers who answered “yes” to even one of these questions will want to support and receive assistance from the Eisenhower National Clearinghouse for Mathematics and Science Education (ENC). Located at Ohio State University, ENC is designed to improve access to math and science resources available to teachers, students, and parents. The Clearinghouse will collect and create the most up-to-date and comprehensive listing of mathematics and science curriculum materials in the nation. The list of resources will then be made available in a database in a variety of formats, including print, CD-ROM, and electronically on-line.

Those with a computer, a modem, and access to the Internet will have free online access to many of the materials collected by the Clearinghouse. For those without electronic access, materials will be available for a nominal charge through the ENC document delivery service. Current plans are for the on-line portion of the Clearinghouse to be available to teachers in November or December 1995.

ENC is now soliciting instructional materials for inclusion in the database.

For more information about ENC, or to request a materials submission form, contact the Eisenhower National Clearinghouse for Mathematics and Science Education, Ohio State University, 1929 Kenny Road, Columbus, OH 43210-1079; phone (614) 292-7784 (the e-mail address is info@enc.org).

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A new set of materials, "It's a Puzzlement," should help clear up some of the confusion. Developed by the National Farm-City Council, this interdisciplinary unit is designed for teachers in grades K-6 who use a thematic approach to teaching.

The materials show how the products from cotton, sheep, and cattle are manufactured into the products students use every day. They include sample lessons that incorporate teaching about the fiber system into social studies, language arts, math, science, and fine arts.

For a science activity, students make natural dyes from onions, blueberries, and marigolds. They experiment to see how different fabrics absorb color. The kit also includes suggestions for follow-up activities and a bibliography of children's books for those who want to explore the topic in more depth.

"It's a Puzzlement," with its emphasis on the important links between rural and urban areas, is ideal for use during Farm-City Week, Ag Week, and other agriculture-related celebrations. Kits are \$5.00, which includes postage. Write the National Farm-City Council, 225 Touhy Avenue, Park Ridge, IL 60068.

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## Technologies for Sustainable Agriculture in the Tropics

ASA Special Publication Number 56

The land and its related natural resources provides for our basic needs and serves as the source of most of the world's accumulated wealth. Today, sustainability of agriculture is of concern to people throughout the world. Nowhere is the sustainability issue of greater concern than in the tropics. It is in the tropics where population, a fragile environment, and the need for foreign currency put a strong demand on the remaining natural resources.

*Technologies for Sustainable Agriculture in the Tropics*, ASA Special Publication Number 56, explores the assessment of many international tropical experts. The softcover publication is divided into seven sections—basic concepts, technological options, agroforestry and nutrient cycling, vegetative hedges for erosion management, computer models, socio-economic considerations, and case studies from sub-Saharan Africa. This book serves as a valuable reference for those individuals that want to develop and promote the technologies that will help sustain a valuable resource—the tropics.

*Technologies for Sustainable Agriculture in the Tropics*. John Ragland and Rattan Lal, editors. Published by the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. ASA Special Publication Number 56. Softcover, 313 pages, 1993. ISBN 0-89118-118-0. Price: \$30.00 (members' first copy \$25.00).

Please send me \_\_\_\_\_ copy(ies) of *Technologies for Sustainable Agriculture in the Tropics*.

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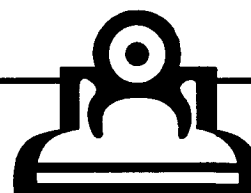
**FAX Your Order 24 Hours a Day 608-273-2021**

1995

- American Forage and Grassland Council** annual meeting, 12–16 March, Lexington, KY (606/257-3144).
- National Science Teachers Association** annual meeting, 23–26 March, Philadelphia, PA (703/243-7100).
- International Symposium on Weed and Crop Resistance to Herbicides**, University of Cordoba, Spain (57 218439, Dr. Jesus Morin).
- Association of American Geographers** annual meeting, 15–19 April, Chicago, IL (202/234-1450).
- National Symposium on Stand Establishment of Horticultural Crops**, 23–26 April, Monterey, CA (916/752-7049).
- Symposium on Planning for a Sustainable Future: The North American Great Plains**, 8–10 May, Lincoln, NE (402/472-6707).
- American Geophysical Union** spring meetings, 29 May–2 June, Baltimore, MD (202/939-3203).
- Clay Minerals Society** annual meeting, 4–8 June, Baltimore, MD (301/405-1344).
- Western Society of Soil Science** annual meeting, 18–22 June, University of British Columbia, Vancouver.
- American Society of Agricultural Engineers** annual meeting, 18–23 June, Chicago, IL (616/429-0300).
- International Herbage Seed Conference** annual meeting, 18–23 June, Halle, Germany (0345-818340).
- Western Society of Crop Science** annual meeting, 19–21 June, Colorado State University, Fort Collins.
- Northeastern Branch ASA** annual meeting, 25–28 June, University of Maine, Orono.
- North Central Branch ASA** annual meeting, 17–19 July, College Park Facility, Grand Island, NE.
- American Society of Animal Science** annual meeting, 23–27 July, Orlando, FL (217/356-3182).
- American Society of Plant Physiologists** annual meeting, 29 July–2 August, Charlotte, NC (301/251-0560).
- American Society for Horticultural Science** annual meeting, 30 July–3 August, Montreal, Canada (703/836-4606).
- Ecological Society of America** annual meeting, 31 July–3 August, Snowbird, UT (602/965-3000).
- Soil and Water Conservation Society** annual meeting, 6–9 August, Des Moines, IA (515/289-2331 or 800/843-7645, ext. 12).
- AIBS** annual meeting, 6–10 August, San Diego, CA (800/992-2427 or 202/628-1500, ext. 204).
- American Phytopathological Society** annual meeting, 12–16 August, Pittsburgh, PA (612/454-7250).
- Society of American Foresters** annual meeting, 28 October–1 November, Portland, ME (301/897-8720).
- American Society of Agronomy, Crop Science Society of America, Soil Science Society of America** annual meeting, 29 October–3 November, St. Louis, MO (608/273-8080).
- Geological Society of America** annual meeting, 6–9 November, New Orleans, LA (800/472-1988 or 303/447-2020).
- American Association for Agricultural Education** annual meeting, 1–5 December, Denver, CO (607/255-2197).

1996

- Weed Science Society of America** annual meeting, 5–8 February, Norfolk, VA (217/352-4212).
- Society for Range Management** annual meeting, 10–15 February, Wichita, KS (303/355-7070).
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- American Society of Agronomy, Crop Science Society of America, Soil Science Society of America** annual meeting, 3–8 November, Indianapolis, IN (608/273-8080).



## Teacher's Bulletin Board

Do you have a quick note to share with readers of the journal? Do you want your students "connected" with students in similar courses at other universities? Perhaps instructors who would welcome this interaction could post their interest in this section. This Bulletin Board is set aside for such items, with a limit of 50 words. Bulletin Board items are free of charge, subject to editing for length and clarity, and must comply with the intent of this section. No position announcements or classified ads are permitted. Send your item to: JNRLSE Managing Editor, Susan Ernst, at the American Society of Agronomy headquarters office, 677 S. Segoe Road, Madison, WI 53711; fax (608) 273- 2021.

## Classroom News

**Please Share Classroom News with a K-12 Teacher You Know.** Here is a hand-picked selection of news and ideas published in the Spring 1995 issue of the *Journal of Natural Resources and Life Sciences Education*. These news items are selected especially for teachers of grades K-12. We hope you find them useful. And we welcome your ideas for other types of information you would like to see in the journal; write an editorial, letter to the editor, or even an article for review and possible publication! (The journal is peer-reviewed and there are minimal page charges for articles.) Check out the journal—you might just find some useful information for classroom, labs, quizzes, or field trips! Become a subscriber! For more information, contact the managing editor, Susan Ernst, at the American Society of Agronomy headquarters office, 677 S. Segoe Road, Madison, WI 53711; phone (608) 273-8080 or fax (608) 273-2021. Sit back and enjoy!

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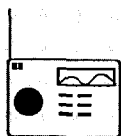
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### Teach Science via Radio

Following last year's successful debut as a pilot program, the American Association for the Advancement of Science (AAAS) children's radio adventure—the *Kinetic City Super Crew*—flourished when the first of more than 90 new episodes reached the airwaves last fall, thanks to a recent \$3 million grant from the National Science Foundation.

The program, which emulates radio dramas of the past to teach children about science and technology, aims to capture the imagination of third, fourth, and fifth grade students through the intrigue of mystery and the mastery of problem-solving. The new episodes will strive to repeat the success of the four pilot shows, which received favorable responses from young listeners, particularly girls and minorities.

Instructions for simple, at-home experiments are featured, providing listeners with a hands-on activity to reinforce learning. A toll-free number for the program encourages the children to call and discuss the results of their experiment. Selected calls will be incorporated into the future episodes of *Kinetic City Super Crew*.

The program is being offered to radio stations in the USA that target children and young adults as their primary audience, and stations with a significant element of children's programming. For more information, call Ellen Cooper at (202) 326-6431.■

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To obtain the quantity in SI units, the original units should be multiplied by the conversion factor, for example, to convert a length of 10 inch to metre units multiply by 0.025 4 giving 0.254 m. To convert from one non-SI unit to another non-SI unit, first convert to the SI unit by multiplying by the conversion factor and. then convert to the other non-SI unit by dividing by the conversion factor for the other unit. If multiple units are involved, convert each separately by multiplying by the appropriate conversion factor for any units with positive powers and dividing by the appropriate con...Â The SI and Imperial units are identical. Angular velocity is normally calculated from N revolutions/s by. 2 N.