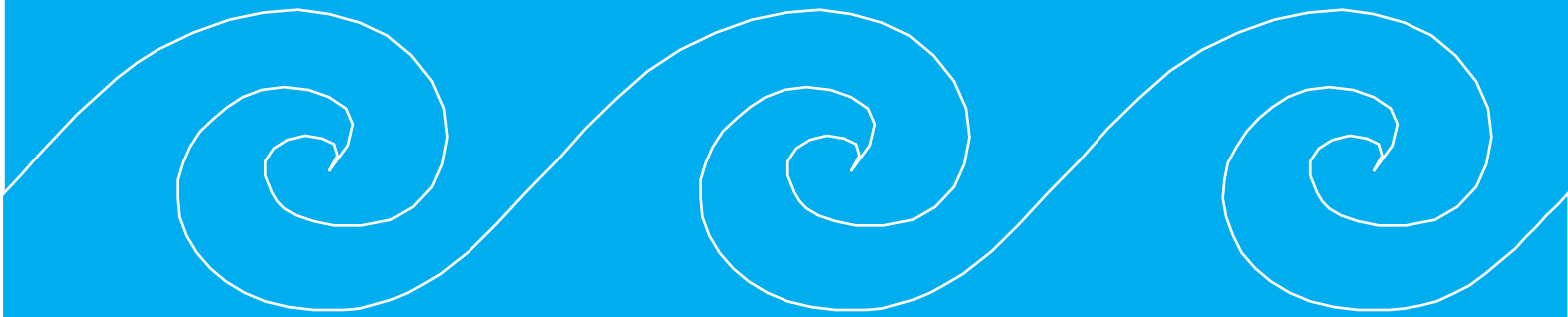
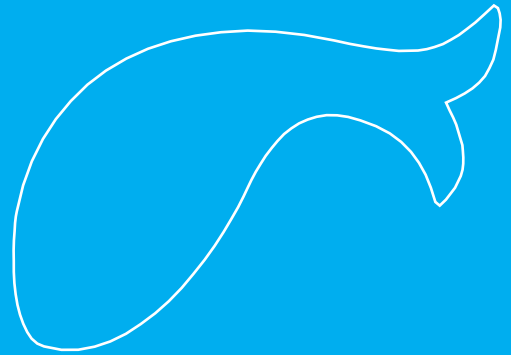


Aquaculture Curricula Resource Guide

a resource tool for the aquaculture educator

Scott J. Soares, Joseph K. Buttner and Dale F. Leavitt



This guide is also available online at: www.massdfa.org/markets/aquaculture



Massachusetts Department of Food & Agriculture

Northeastern Regional

Aquaculture
Center



Aquaculture Curricula Resource Guide: a resource tool for the aquaculture educator

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Executive Summary

A number of elementary, secondary and post secondary science education programs have demonstrated that educational experiences are enhanced when aquaculture is incorporated into the instructional program. Whether teaching about aquaculture or with aquaculture, its hands-on, real-life nature positively impacts student enthusiasm and willingness to actively participate in classroom activities. A variety of aquaculture curricula exist and are used by educators nationally to facilitate the integration of aquaculture into their classrooms. Selection of an aquaculture curriculum appropriate for a specific program can be daunting, particularly for the novice educator with limited time and familiarity of available resources. The purpose of this *Aquaculture Curricula Resource Guide* is to inform educators about aquaculture curricula and instructional materials.

Information about aquaculture curricula used in the classroom and its availability was obtained from responses to a survey that was mailed to 359 extension contacts, educators and institutions. Forty-nine respondents identified 25 distinct educational materials and curricula resources.

To determine which of the identified materials could be considered a curriculum and appropriate for this project, a definition of “aquaculture curriculum” was developed:

A specific set of commercially available instructional materials that are systematically organized, covering the breadth of aquaculture, including background information, student learning activities and some form of assessment.

Using this definition, 13 of the 25 materials identified by survey respondents were categorized as curriculum. A team read and evaluated each curriculum for five categories; Coverage and Quality, Organization and Structure, Format and Readability, Assessment, and Teacher Resources.

The *Aquaculture Curricula Resource Guide* reports survey results, evaluations and specific comments for each reviewed curriculum. Additional aquaculture educational resources identified by survey respondents but failed to meet the definition of an aquaculture curriculum were not evaluated. They are included in the appendices as additional aquaculture educational materials.

Introduction

The *Aquaculture Curricula Resource Guide* was developed to identify existing commonly used aquaculture instructional materials for educators interested in integrating aquaculture into existing programs or in establishing new aquaculture education programs. The primary objectives of the project were as follows:

1. *Identify, review and describe existing aquaculture curricula developed for a variety of educational levels.*
2. *Synthesize summaries of surveyed curricula and catalog these according to target audience, content, source and utility.*
3. *Provide educators with a comprehensive aquaculture curricula resource guide to enhance aquaculture education efforts.*
4. *Increase public awareness and enhance aquaculture education endeavors, thereby improving conditions for sustainable development of the aquatic farming industry in the Northeastern United States and elsewhere.*

In the Northeastern United States, local economies have been severely impacted by the lingering fisheries crisis and waning agricultural industries. Cultivation of aquatic organisms has been recognized as a means to replace some of the lost employment opportunities, allowing diversification of existing agricultural and fisheries enterprises and providing a supplemental source of fish and other seafood. Additionally, and perhaps as important as teaching *about* aquaculture through training programs and workshops, teaching *with* aquaculture has provided educators with a new tool that has utility across disciplines. With this recognition it has become increasingly important to establish education programs that expose students to the science and technology of aquaculture, provide training to obtain vocational skills and serve as a vehicle for education of the general public and governmental education. To that end numerous studies and state aquaculture development plans have identified the need for aquaculture education and training opportunities at various levels. For example, Volk (1986) encouraged the introduction of aquaculture education programs at all levels of public schools as an important component to the efficient utilization of Connecticut's aquatic resources. Massachusetts Coastal Zone Management (1995) put forward three recommendations regarding education needs of the Commonwealth. These included establishment of a curriculum grants program for secondary schools, allocation of funds for aquaculture training and appropriation of new funding for degree programs in aquaculture. The Maine Coastal Program State Planning Office (1990) identified the lack of production and technology information and an absence of training programs among the impediments to aquaculture development in Maine. The Virginia Aquaculture Plan (Newton 1995) recommended that aquaculture education programs be developed and expanded and that aquaculture subject matter should be included in secondary and post secondary curricula.

The introduction of new material, concepts and topics within an educational setting is a labor-intensive effort, particularly if resource materials are scattered and difficult to access. This *Aquaculture Curricula Resource Guide* provides a comprehensive, although not exhaustive, list and description of curricula that are commercially available and have been utilized by aquaculture educators. The document provides an assessment of the

content and utility of these aquaculture curricula and the work undertaken to complete this project in the following sections and appendices.

How to Use the *Aquaculture Curricula Resource Guide* offers an example of how the information in this publication can be used to identify and obtain aquaculture curriculum and/or educational resource material.

Methods provides details regarding the work done to complete the *Aquaculture Curricula Resource Guide* including the development of a definition for “aquaculture curriculum”, the identification, selection and analysis of curricula reviewed by this project.

Findings includes a summary (Table 1) and one-page profiles for each curricula reviewed. The profiles provide a “thumbnail” reference to the evaluation assessment with regard to five evaluation categories from a curriculum analysis worksheet and comments that provide greater details about each curriculum.

Conclusion and References provide concluding remarks and a bibliography for the references cited within this document.

Appendices (A – E) present details about other aquaculture educational materials and methods used to identify and describe the aquaculture curricula reviewed by the *Aquaculture Curricula Resource Guide*. Included are additional aquaculture education materials identified, but not evaluated by this project, the letter and survey form used to collect information about currently used aquaculture curricula, the work sheet used for curriculum analysis, detailed information on the aquaculture curricula evaluated and individual assessments for each aquaculture curricula evaluated.

How to Use the *Aquaculture Curricula Resource Guide*

Designed to aid educators in their selection of aquaculture resources for use in their classrooms, the *Aquaculture Curricula Resource Guide* reviews 13 commercially available curricula. Educators contemplating instruction of an aquaculture course or incorporation of aquaculture as a teaching supplement into an existing course are encouraged to examine the entire *Aquaculture Curricula Resource Guide* as well as additional educational resource materials before selecting a particular curriculum. Each curriculum is evaluated as **STRONG**, **ADEQUATE** or **WEAK** with regard to five categories: Coverage and Quality, Organization and Structure, Format and Readability, Assessment, and Teacher Resources.

Aquaculture is a dynamic and rapidly growing discipline with new findings and publications generated continuously and materials surveyed by the *Aquaculture Curricula Resource Guide* are not exhaustive of what is available. The intent of this publication is to provide information in a user friendly, efficient manner to educators who have limited aquaculture experience thereby establishing a starting point for access to aquaculture education materials and resources.

The table, curricula profiles and appendices included in this publication can be used to simplify the selection of aquaculture curricula for a particular education program. As an example, based upon the relative strengths and weaknesses reported for each curriculum in Table 1, *Summary of evaluations for the aquaculture curricula reviewed*, the 2-3 curricula that are most appropriate for a specific program's needs can be identified.

Using the "page number of profile" field in Table 1, *Summary of evaluations for the aquaculture curricula reviewed*, Curricula Profiles that provide detailed information about each curriculum can then be used to help refine decisions regarding the applicability of a particular curriculum.

After a particular curriculum is identified, Appendix C, *Information on the aquaculture curricula evaluated in the Aquaculture Curricula Resource Guide*, can be used to contact distributors and order the curriculum.

If aquaculture topics of specific or narrow focus are being considered, or if the instructor is interested in supplemental materials for an existing aquaculture education program, Appendix E, *Additional aquaculture education material identified but not evaluated by the Aquaculture Curricula Resource Guide*, provides a listing of helpful aquaculture resource materials.

Methods

It was not the intent of the *Aquaculture Curricula Resource Guide* to identify every aquaculture curriculum that was available at the time of the project's development but rather to identify and describe curricula currently employed by educators from elementary school through university programs. The following identification and review methods were employed toward the completion of the project.

Curriculum Identification:

Information about aquaculture curricula used in the classroom and its availability was obtained through responses to a survey that was mailed to 359 extension contacts, educators and institutions (Appendix B). A 14% response rate was achieved. Nineteen of the 49 responses did not provide any information regarding aquaculture curricula or educational materials used. Thirteen responses identified educational materials exclusive of texts. Thirteen responses identified texts and other educational materials. Four responses included samples of texts and materials. Collectively, 25 distinct educational materials and resources were identified and augmented by the project team.

Curriculum Review:

To determine which materials would be considered a curriculum and appropriate for review in this project, a definition of "aquaculture curriculum" was developed:

A specific set of commercially available instructional materials that are systematically organized, covering the breadth of aquaculture, including background information, student learning activities and some form of assessment.

Using this definition, 13 of the 25 materials identified by survey respondents were characterized as curricula and reviewed using a curriculum analysis work sheet modified from materials employed by the Chelsea, Massachusetts school district to evaluate and select instructional materials (Appendix D).

Three copies of each curriculum were obtained. A curriculum evaluation team (Dr. Joseph K. Buttner, Northeastern Massachusetts Aquaculture Center and Department of Biology, Salem State College; Dr. Dale F. Leavitt, Woods Hole Oceanographic Institution Sea Grant, Cape Cod Cooperative Extension Service and the Southeastern Massachusetts Aquaculture Center; and Mr. Scott J. Soares, Aquaculture Program, Massachusetts Department of Food and Agriculture) read and independently evaluated each curriculum. Each curriculum was evaluated numerically according to five categories that contained multiple criteria: Coverage and Quality, Organization and Structure, Format and Readability, Assessment, and Teacher Resources. Each evaluator assigned a numeric value (0-3) to 46 separate criteria reviewed for each curriculum. Numeric values within each of the five evaluation criteria were averaged and identified as **WEAK** (0.01-1.00), **ADEQUATE** (1.01-2.00) or **STRONG** (2.01-3.00). A summary of the evaluation assessments for the 13 aquaculture curricula evaluated by the *Aquaculture Curricula Resource Guide* are reported in Table 1.

Mean and standard deviation of the numeric scores for each of the 46 criteria examined were determined for all curricula surveyed (Appendix E). General information about each curriculum including title, author, source, and cost, overall evaluation of each curriculum, and observations by evaluators, in bulleted format, are reported in *Findings*.

Publication:

Publication services were contracted following the procurement guidelines of the Commonwealth of Massachusetts that recommend a bid-for-service process that included solicitation of three competitive vendors. To that end, bid specifications were developed and sent to three potential vendors. Condor Press Inc., Dorchester, MA, was selected for contract development. One thousand five hundred (1,500) hard copies of this publication were generated and three hundred and fifty (350) copies were provided to the Northeastern Regional Aquaculture Center in accordance with its publication requirements. The remaining copies were retained by the Massachusetts Department of Food and Agriculture (251 Causeway St. Suite 500, Boston, MA 02114-2151) and the New England Board of Higher Education (45 Temple Place, Boston, MA 02111) for further distribution through the National Association of State Aquaculture Coordinators, the National Science Foundation, the National Marine Educators Association, State departments of education, State representatives of the Northeast region Agriculture in the Classroom program, Sea Grant offices, and selected university and public libraries from West Virginia to Maine. The Guide has also been published electronically and is available as a downloadable file through the Massachusetts Department of Food and Agriculture Aquaculture Program web page (www.massdfa.org/markets/aquaculture) and the New England Board of Higher Education web page (www.nebhe.org).

Findings

Reviews of curricula are summarized in Table 1 that is followed by one page profiles of each curriculum evaluated. Table 1 includes title, author, overall evaluation and a break down of the overall evaluation into the five review categories for each curriculum. Cost may play a role in curriculum selection so that information is also provided. The Page Number for Profile column directs the reader to the page in this *Aquaculture Curricula Resource Guide* where further details about each curriculum can be found.

Table 1. Summary of evaluations for the aquaculture curricula reviewed.

Evaluation Key: STRONG (2.01-3.00) - provides <u>outstanding</u> coverage of the item ADEQUATE (1.01-2.00) - provides <u>acceptable/average</u> coverage of the item WEAK (0.01-1.00) - provides <u>minimal</u> coverage of the item NOT ADDRESSED (0.00) - does not address the item or item is not applicable									
Author/Editor Title	Overall Evaluation	Coverage & Quality	Organization & Structure	Format & Readability	Assessment	Teacher Resources	Cost	Page Number for Profile	
Belusz, L. C. <i>Instructor Lesson Plans for Mathematical Concepts and Measurement of Fish Performance and Water Management in Classroom Aquaculture</i>	STRONG	ADEQUATE	STRONG	ADEQUATE	STRONG	ADEQUATE	\$159.00	11	
Crochet, G. and M. Murphy <i>Mississippi Curriculum Framework for Aquaculture</i>	STRONG	STRONG	STRONG	STRONG	ADEQUATE	ADEQUATE	free	12	
Foster, J. R. <i>Practical Aquaculture: A High School Curriculum Based on Hands-on Experiential Learning</i>	ADEQUATE	ADEQUATE	STRONG	ADEQUATE	ADEQUATE	ADEQUATE	\$25.00	13	

Table 1. Summary of evaluations for the aquaculture curricula reviewed. (Cont.)

Evaluation Key:									
STRONG (2.01-3.00) - provides <u>outstanding</u> coverage of the item		ADEQUATE (1.01-2.00) - provides <u>acceptable/average</u> coverage of the item							
WEAK (0.01-1.00) - provides <u>minimal</u> coverage of the item		NOT ADDRESSED (0.00) - does not address the item or item is not applicable							
Author/Editor Title	Overall Evaluation	Coverage & Quality	Organization & Structure	Format & Readability	Assessment	Teacher Resources	Cost	Page Number for Profile	
Hudson, C. J. <i>Aquaculture Infusion Units</i>	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	\$24.00	14	
Landau, M. <i>Introduction to Aquaculture</i>	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	WEAK	WEAK	\$77.95	15	
Lee, J. and M. Newman <i>Aquaculture: An Introduction 2nd Edition</i>	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	WEAK	\$40.00	16	
Lee, J. and Associates Ed. <i>Aquaculture How To Series</i>	ADEQUATE	ADEQUATE	STRONG	STRONG	ADEQUATE	ADEQUATE	free	17	
Parker, R. <i>Aquaculture Science</i>	STRONG	STRONG	STRONG	STRONG	STRONG	ADEQUATE	\$80.00	18	

Table 1. Summary of evaluations for the aquaculture curricula reviewed. (Cont.)

Evaluation Key:									
STRONG (2.01-3.00) - provides <u>outstanding</u> coverage of the item		ADEQUATE (1.01-2.00) - provides <u>acceptable/average</u> coverage of the item							
WEAK (0.01-1.00) - provides <u>minimal</u> coverage of the item		NOT ADDRESSED (0.00) - does not address the item or item is not applicable							
Author/Editor Title	Overall Evaluation	Coverage & Quality	Organization & Structure	Format & Readability	Assessment	Teacher Resources	Cost	Page Number for Profile	
Rice, M. A. <i>Laboratory Manual Shellfish Aquaculture</i>	ADEQUATE	ADEQUATE	STRONG	ADEQUATE	WEAK	WEAK	\$10.00	19	
Swann , L., J. Brown, S. Katz, R. Merzdorf <i>Getting Started in Freshwater Aquaculture: an interactive learning experience</i>	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	\$60.00	20	
The National Council for Agricultural Education <i>Aquaculture Curriculum Guide: 5 Module Set</i>	ADEQUATE	ADEQUATE	ADEQUATE	ADEQUATE	STRONG	STRONG	\$56.00	21	
Walker, S. S. <i>Aquaculture: Second Edition</i>	STRONG	STRONG	STRONG	STRONG	STRONG	ADEQUATE	\$132.50	22	
White, S. ME/NH Sea Grant <i>Aquaculture in Maine: A curriculum guide for secondary school teachers</i>	ADEQUATE	STRONG	STRONG	STRONG	ADEQUATE	ADEQUATE	\$25.00	23	

The following 13 pages provide a one page profile for each curriculum reviewed. Each Curriculum Profile includes a Title Block, Evaluation Block and a Comments Block (see below). The Title Block provides general information about the curriculum (author, title, date, source, ISBN number and cost). The Evaluation Block provides an evaluation summary regarding the relative strength of the curriculum evaluations for each of the five evaluation criteria (Content: Coverage and Quality, Content: Organization and Structure, Content: Format and Readability, Assessment, and Teacher Resources). The Comment Block provides, in bulleted format, comments and specific details about the curriculum.

The following key describes the components of the Curriculum Profile.

The diagram shows a Curriculum Profile form divided into three main sections:

- Title Block:** A box containing fields for AUTHOR, TITLE, DATE, SOURCE, ISBN, and COST.
- Evaluation Block:** A table with two columns: CRITERIA and SCORE. The criteria listed are OVERALL, Content: Coverage and Quality, Content: Organization and Structure, Content: Format and Readability, Assessment, and Teacher Resources.
- Comments Block:** A large box containing a bulleted list of lines for entering comments.

Arrows from the text on the right point to these sections:

- An arrow points from the text "Title Block provides author, title, date, source and cost information." to the Title Block.
- An arrow points from the text "Evaluation Block provides the overall score and the evaluations for each of the five evaluation criteria (Content: Coverage and Quality, Content: Organization and Structure, Content: Format and Readability, Assessment, and Teacher Resources)" to the Evaluation Block.
- An arrow points from the text "Comments Block provides a bulleted synthesis of the evaluators' comments for the curriculum" to the Comments Block.

AUTHOR:	<i>Belusz, Lawrence C.</i>		
TITLE:	<i>Instructor Lesson Plans for Mathematical Concepts and Measurement of Fish Performance and Water Management in Classroom Aquaculture</i>		
SOURCE:	<i>Aquatic Eco-Systems Inc.</i>	DATE:	<i>1996</i>
ISBN:	<i>N/A</i>	COST:	<i>\$159.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	STRONG
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	STRONG
<i>Teacher Resources</i>	ADEQUATE

- An effective collection of activities for application of aquaculture to high school mathematics. Also excellent curriculum for college course.
- Good compilation of laboratory activities that can stand alone, but also build on each other.
- Activities covered are essential to aquaculture and doable in the classroom with limited financial requirements.
- Objectives, background information, assessment, illustrations, lists of resource requirements and materials needed are provided.
- Good tips peppered throughout for teachers.
- An excellent overview of aquaculture globally, although value is somewhat diminished by age of document.
- Application is limited to mathematical concepts but the information is good.
- Chemical use is covered adequately but other areas of lab safety would benefit from expanded coverage.
- Quality varies among the many overheads included. Many are crowded and may be difficult to view as overheads. Simplification of overheads would provide greater clarity.
- Colored visuals would liven-up the curriculum.
- More use of metric system would increase the utility of this curriculum.
- Best used as a reference tool vs. a classroom instruction resource. Perhaps too much detail for some sections and lack of sufficient detail in other sections (e.g. water quality).
- Some minor typos (e.g. overhead #4 lesson 10, overhead #3 lesson 2).
- Publication would benefit from pagination and reference citations.

AUTHOR: *Crochet, Greg & M. Murphy*

TITLE: *Mississippi Curriculum Framework for Aquaculture* DATE: *1998*

SOURCE: *Mississippi Department of Education*

ISBN: *N/A* COST: *FREE*

CRITERIA

SCORE

OVERALL

STRONG

Content: Coverage and Quality

STRONG

Content: Organization and Structure

STRONG

Content: Format and Readability

STRONG

Assessment

ADEQUATE

Teacher Resources

ADEQUATE

- Goal of this curriculum is to teach about aquaculture, although useful references are made to National/State education and science standards.
- Good as guidance for development of an aquaculture course and for course content.
- Excellent list and sequence of topics. Good approach to teaching goals, what should be taught and how.
- Clearly aimed at instructors at the high school level.
- Aquaculture course outline leaves content up to the discretion of the instructor. Instructor may need an aquaculture background and the ability to flesh out the program described by the document with specific activity and content sources.
- Assessment tools provided are primarily multiple choice and fill in the blanks.
- Resource materials are good although generic and not specific to the activity.
- Considerable redundancy in material. Two courses are described that overlap. Some of the information presented in Aquaculture I could be transferred to Aquaculture II to balance the information content.
- More hands-on examples would be helpful.
- Curriculum is developed consistent with the Mississippi education frameworks.

AUTHOR:	<i>Foster, John R</i>	DATE:	<i>1998</i>
TITLE:	<i>Practical Aquaculture: A High School Curriculum Based on Hands-on Experiential Learning</i>		
SOURCE:	<i>Fisheries & Aquaculture State University of New York</i>		
ISBN:	<i>N/A</i>	COST:	<i>\$25.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	ADEQUATE
<i>Teacher Resources</i>	WEAK

- The focus of this curriculum is narrowly tuned to growing Tilapia in a water recirculating culture system.
- This curriculum is one of three components of an education program aimed at the introduction of aquaculture science and technology through hands-on experience of growing Tilapia in a closed recirculation system. The other two components, a tank culture system (Aqua-Tech and Aqua-Tech II) designed by the curriculum developers and professional technical assistance also provided by the curriculum developers, were not evaluated by this project.
- Optimal benefit from this curriculum results from the implementation of the complete program (including the printed material, technical assistance and equipment from the curriculum developers). Schools that are in the SUNY Cobleskill service area have the benefit of technical assistance and access to a water recirculating system designed specifically for Tilapia culture
- Provides good hands-on opportunities to explore scientific concepts.
- Provides an excellent classroom reference book.
- Curriculum provides good connection with the sciences, but little extension into other disciplines.
- Supplemental resources are discussed in the curriculum, but inclusion of relevant literature cited at the end of each section would be beneficial.
- Figures and graphics are inconsistent in quality and breadth. Nonetheless, figures and graphs could easily be used for overhead production.
- Curriculum would benefit from the inclusion of fish spawning information.
- Curriculum is not specifically aligned with the New York State or National Standards.

AUTHOR:	<i>Hudson, C. Jordan</i>		
TITLE:	<i>Aquaculture Infusion Units</i>	DATE:	<i>1997</i>
SOURCE:	<i>Commonwealth of Virginia, Virginia Department of Education, Office of Vocational and Adult Education Services</i>		
ISBN:	<i>N/A</i>	COST:	<i>\$24.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	ADEQUATE
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	ADEQUATE
<i>Teacher Resources</i>	ADEQUATE

- Curriculum is aligned with tasks/competencies associated with Virginia agricultural education and is designed as a supplement to a much broader agriculture education program.
- Curriculum includes many overheads.
- Problem solving tasks provide students with opportunities for reasoning and analytical tasks.
- Progression of topic areas in the publication contributes to the integration of information presented in previous sections.
- Curriculum provides a good introduction to low intensity freshwater aquaculture (cage/pond). Other forms of aquaculture are covered minimally.
- Relies upon the instructor to collect much of the material and is well suited for an instructor that has aquaculture experience.
- Suggestions for lab reports and teacher prepared exams, but no evaluation instruments are presented. Instrument type and design left up to the instructor's discretion.
- Can not stand alone as a comprehensive aquaculture curriculum; should be used in combination with other aquaculture education materials.
- Incorporation of linkages between science and non-science disciplines is encouraged, but not specific.
- Although very little direct science application, includes opportunities to use a variety of science process skills and requires using a wide assortment of analytical instruments and tools although somewhat instructor dependent.
- Some content information is dated.

AUTHOR:	<i>Landau, Matthew</i>		
TITLE:	<i>Introduction to Aquaculture</i>	DATE:	1992
SOURCE:	<i>John Wiley & Sons Inc.</i>		
ISBN:	<i>0-471-61146-8</i>	COST:	\$77.95

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	ADEQUATE
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	WEAK
<i>Teacher Resources</i>	WEAK

- Presents strong general overview of aquaculture.
- Good for background information and as a resource for classical aquaculture literature.
- Good technical information for all potential aquaculture situations.
- Visuals were good, but photograph quality could be improved.
- Many of the references provided remain relevant, however some of the material is dated.
- No specific encouragement for student dialogue, although the need for further investigation is expressed in the curriculum. Alternative practices of achieving the same end are often referenced.
- Assessment and teacher resources are not within the stated objectives of the curriculum and are not included.
- Designed as a college text to provide overview information regarding aquaculture globally.

AUTHOR:	<i>Lee, Jasper and Michael Newman</i>		
TITLE:	<i>Aquaculture: An Introduction 2nd Edition</i>	DATE:	<i>1997</i>
SOURCE:	<i>Interstate Publishers Inc.</i>		
ISBN:	<i>0-8134-3084-4</i>	COST:	<i>\$40.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	ADEQUATE
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	ADEQUATE
<i>Teacher Resources</i>	WEAK

- Readable and appropriate for junior high school and as introductory curriculum.
- Information presented in this publication is broader than it is deep.
- Curriculum uses some unconventional terms and there are some inaccuracies.
- Increasing the quality and reference to photographs and figures to text would improve this publication.
- Teacher resource materials such as citations and suggestions for further reading are absent.
- Superficial coverage of recirculating aquaculture systems diminishes the value of the publication.

AUTHOR:	<i>Lee, Jasper and Associates</i>		
TITLE:	<i>Aquaculture How To Series</i>	DATE:	<i>1999</i>
SOURCE:	<i>National Council for Agricultural Education</i>		
ISBN:	<i>N/A</i>	COST:	FREE

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	STRONG
<i>Assessment</i>	ADEQUATE
<i>Teacher Resources</i>	ADEQUATE

- Good exercises with coverage of mini-recirculation systems, aquariums and aquaponics.
- Good marketing section is presented and the resource section is informative and helpful.
- Mathematics and science applications sections are good but, may be too basic for the target grade level (high school).
- Laboratory activities sections would benefit from better organization and assessment tools.
- There are some inaccuracies.
- This publication has much more value as a supplement to a core aquaculture curriculum (for example, 1992 National Council for Agricultural Education publication included in this review) than as a stand-alone curriculum.

AUTHOR:	<i>Parker, Rick</i>		
TITLE:	<i>Aquaculture Science</i>	DATE:	<i>1995</i>
SOURCE:	<i>Delmar Publishers</i>		
ISBN:	<i>0-8273-6454-7</i>	COST:	<i>\$80.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	STRONG
<i>Content: Coverage and Quality</i>	STRONG
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	STRONG
<i>Assessment</i>	STRONG
<i>Teacher Resources</i>	ADEQUATE

- Nicely assembled, well written and comprehensive also includes business, education and training components.
- Includes information for every aspect of aquatic production from setup to harvest and marketing. An effective teaching tool for high school aquaculture.
- Comprehensive curriculum package including a text, instructor guide and laboratory activities manual.
- Chapters are nicely formatted with well-defined objectives. Good questions at the end of each section.
- Good coverage of crustacean and molluscan anatomy.
- Optional teacher's guide serves predominantly as an answer key for questions.
- Depth and breadth of coverage varies; pond vs. raceway/tank, catfish vs. shellfish, freshwater vs. marine. Freshwater pond culture is covered in-depth while marine culture is not. Catfish culture is covered in depth while shellfish culture is not.
- This curriculum was developed in 1990 and could use updating. Information about HACCP is lacking and information regarding oyster diseases is outdated.
- Sequence in textbook does not align well with laboratory manual.
- Some problems with scientific accuracy. For example, mollusk genus and species (pg. 40), food chain (pg. 42), ocean salinity (pg. 346). In the laboratory manual there are errors regarding Beer's law (pg. 6) and crawfish anatomy (pg. 32).

AUTHOR:	<i>Rice, Michael A.</i>		
TITLE:	<i>Laboratory Manual Shellfish Aquaculture</i>	DATE:	<i>1998</i>
SOURCE:	<i>University of Rhode Island, Campus Copy & Design</i>		
ISBN:	<i>N/A</i>	COST:	<i>\$10.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	WEAK
<i>Teacher Resources</i>	WEAK

- This curriculum is an excellent laboratory manual for shellfish culture, in particular this publication is a practical resource for shellfish larvae and juvenile rearing.
- The manual is very hands-on and suitable for the classroom as well as practical applications for industry members.
- Good material available specifically for shellfish aquaculture. This type of educational material is not widely available.
- The exercise requesting students to determine the economic feasibility of small-scale shellfish culture is very applicable to commercial shellfish culture.
- Background information is available via references and information embedded in text.
- Activities rely upon information and lessons presented earlier in the curriculum, therefore the sequence presented for activity completion must be maintained.
- No clear assessment instruments are provided, although the development of laboratory reports appears to be the means for evaluating student understanding.
- There is variation between depth of coverage for different topic areas addressed by the publication.
- Accurate graphics and figures of varying quality.
- Provision of clear instructions for using tools, equipment, and materials is variable.
- Curriculum would benefit from an introduction regarding content and use as well as a table of contents.
- Not intended as an overall curriculum rather a support manual for the laboratory component of a college level shellfish culture course.

AUTHOR:	<i>Swann, LaDonn , J. Brown, S. Katz, and R. Merzdorf</i>		
TITLE:	<i>Getting Started in Freshwater Aquaculture: an interactive learning experience</i>	DATE:	<i>1998</i>
SOURCE:	<i>Purdue University / Illinois-Indiana Sea Grant</i>		
ISBN:	<i>0-931682-71-1</i>	COST:	<i>\$60.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	ADEQUATE
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	ADEQUATE
<i>Teacher Resources</i>	ADEQUATE

- Appropriate as a supplement to an aquaculture education program that includes the development of a hypothetical aquaculture farm.
- Edition includes workbook and interactive computer (i.e. CD ROM) component, both components can stand alone, but work better if combined.
- Good outreach vehicle with particular applicability to continuing education for aquaculture industry members rather than an educational curriculum.
- Curriculum is focused on pond aquaculture, targeting vocational-technical and/or business start up audiences.
- Important information is absent such as safety / insurance / building-electric codes.
- A good compilation of useful information.

AUTHOR:	<i>The National Council for Agricultural Education</i>		
TITLE:	<i>Aquaculture Curriculum Guide: 5 Module Set</i>	DATE:	<i>1992</i>
SOURCE:	<i>The National Council for Agricultural Education</i>		
ISBN:	<i>N/A</i>	COST:	<i>\$56.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	ADEQUATE
<i>Content: Organization and Structure</i>	ADEQUATE
<i>Content: Format and Readability</i>	ADEQUATE
<i>Assessment</i>	STRONG
<i>Teacher Resources</i>	STRONG

- Curriculum is primarily aimed at instructors. Topics can be sequenced to meet individual program needs and many overhead masters are provided.
- Activities emphasize conceptual understanding rather than rote learning. Encourages student participation in the classroom as well as in the community.
- Recommendations to invite speakers and visit operational farms assure real world connection.
- Good section on career opportunities in aquaculture and associated fields.
- Minimal narrative for students to read and exams are provided with each module that are directly tied to learning objectives.
- Recommends an experimental approach that builds reasoning and analytical skills, but no actual exercises are provided.
- Background information is limited and many references are dated, for example, references to Tilapia and hybrid striped bass.
- Very limited mention of laboratory, farm, human or product safety issues.
- Resources are repeated for all sections. Specific references relative to each activity are not included.
- Reading level may be low for target audience (high school) age students.

AUTHOR:	<i>Walker, Susan S.</i>		
TITLE:	<i>Aquaculture: Second Edition</i>	DATE:	<i>1996</i>
SOURCE:	<i>The Multistate Academic Vocational Curriculum Consortium, Inc.</i>		
ISBN:	<i>N/A</i>	COST:	<i>\$132.50</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	STRONG
<i>Content: Coverage and Quality</i>	STRONG
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	STRONG
<i>Assessment</i>	STRONG
<i>Teacher Resources</i>	ADEQUATE

- Comprehensive curriculum about aquaculture with sections that can stand-alone or be used collectively.
- Curriculum is multi-disciplined including connections beyond the sciences.
- Very practical, examines a variety of aquaculture equipment and tools.
- Bullet format helps student progress through the curriculum.
- Links terms and concepts presented in previous sections.
- Limited in its representation of the aquaculture industry, focusing on southern US pond culture.
- Coverage is sometimes superficial.
- Designed as vocational agricultural curriculum specifically to target industry and employment requirements.

AUTHOR:	<i>White, S. ME/NH Sea Grant</i>		
TITLE:	<i>Aquaculture in Maine: A curriculum guide for secondary school teachers</i>		DATE: <i>1996</i>
SOURCE:	<i>The Aquaculture Education Coalition, ME Dept. of Education</i>		
ISBN:	<i>N/A</i>	COST:	<i>\$25.00</i>

<u>CRITERIA</u>	<u>SCORE</u>
OVERALL	ADEQUATE
<i>Content: Coverage and Quality</i>	STRONG
<i>Content: Organization and Structure</i>	STRONG
<i>Content: Format and Readability</i>	STRONG
<i>Assessment</i>	ADEQUATE
<i>Teacher Resources</i>	ADEQUATE

- This publication is very readable; presents a good treatment of science and standards with chapters can stand-alone or be used collectively.
- Designed and developed to be specific to Maine. Accordingly, exposure is limited to Maine aquaculture with good information regarding the history/heritage of aquaculture in Maine.
- Print size and typeface ensure legibility; visuals are adequate
- No Internet references, some references are dated, and limited additional resource material (beyond Maine references).
- There are some typographic errors.
- Includes more historical content about Maine aquaculture than exercises in practical aquaculture.

Conclusion

As the aquaculture industry continues to grow regionally, nationally and internationally, the need for education programs that include aquaculture will also increase. Programs that teach about aquaculture can prepare students for employment in the aquaculture industry while programs that use aquaculture as a multidiscipline teaching tool can enjoy the benefit of hands-on learning experiences that enable tangible examples of abstract concepts.

The *Aquaculture Curricula Resource Guide* was developed to simplify the identification and acquisition of aquaculture curricula, thereby, encouraging the introduction of aquaculture into the classroom, increasing exposure to aquaculture and promoting greater opportunities to expand public awareness about aquaculture.

References Cited

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- Massachusetts Coastal Zone Management Office. 1995. Massachusetts Aquaculture White Paper and Strategic Plan. MACZM Executive Office of Environmental Affairs. 100 Cambridge St. Boston, MA 02202
- Newton, S.H. 1995. Virginia Aquaculture Plan. Virginia Department of Agriculture and Consumer Services, P.O. Box 1163, Richmond, VA 23218
- Volk, J. 1986. Connecticut Aquaculture Findings and Recommendations Aquaculture Commission. State of Connecticut Department of Agriculture-Aquaculture Division. Rogers Ave, Milford, CT 06460

Appendix A:

**Additional aquaculture education material identified, but not evaluated by the
*Aquaculture Curricula Resource Guide.***

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Many of the aquaculture education materials identified from the responses to this project's survey instrument did not satisfy the definition of "aquaculture curriculum" developed for this project. Nonetheless, these materials can be very helpful as supplemental materials to aquaculture education programs. The following table provides a synopsis of the additional aquaculture education materials that were identified through this project's survey instrument.

Program/Title (year)	Author / Source	Format	Comments
A Basic Overview of Aquaculture (1990)	Illinois-Indiana Sea Grant College Program, 1200 Forest Products Building, West Lafayette, IN 47907-1200	Unknown format	Discusses the history of aquaculture, water quality requirements, types of aquaculture and different production systems. Recommended as appropriate for grades 9 and up. Publication # AS-457 is 11 p and cost is \$3.00
A Guide to Soft Shell Crabbing (1984)	N. Davis and W. Westcott North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone: (919) 515-2454 Fax: (919) 515-7095	Unknown format	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG-84-01 cost \$3.00.
A Manual for Farming the Hard Shell Clam in Florida (1997)	Aquaculture Center for Training Education and Demonstration (ACTED) Aquaculture Division. 5600 U.S. 1 North, Ft. Pierce, FL 34946-7320 Telephone: (561) 466-4984	Three hole punched Manual	Update to "A Manual for Farming the Hard Shell Clam in Florida" by Vaughan, Creswell and Pardee (1990). Provides basic information for hard shell clam culture in Florida including biological, technical and economic information.
Alabama Cooperative Extension Service	Department of Fisheries and Allied Aquaculture Auburn University Auburn, AL 36849 U.S.A. www.ag.auburn.edu/dept/faa/extprog.html Telephone: (334) 844-4786 Fax: (334) 844-9208	Fact sheets and videos	Web site lists fact sheets from SRAC and Alabama Cooperative Extension Service at Auburn University that can be ordered through the site.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
AquaCalc 1.0 (1998)	Staresinic and Treece Texas Sea Grant College Program Texas A & M University 1716 Briarcrest Suite 702 Bryan, TX 77802	Software	Software to aide in design and operation of Aquaculture Systems. Author recommends appropriate for grade levels 12 and up. Cost is \$25.00
Aquaculture Education Electronic Instructional Library CD-ROM	National Council for Agricultural Education 1410 King Street Suite 400 Alexandria, VA 22314 www.teamaged.org Telephone: (800) 772-0939 Fax: (703) 838-5888	CD-ROM	Electronic package that contains all of the aquaculture education materials released by The Council. The material is available from The Council for \$120.00
Aquaculture Technician Program Diploma	Sir Sandford Fleming College School of Environmental and Natural Resource Sciences Albert Street South, P.O. Box 8000, Lindsay, ON Canada K9V 5E6, Telephone: (705) 324-9144 Fax: (705) 878-9312 http://www.flemingc.on.ca/	Education program	College level program that uses a variety of instructional materials in a course of study that concludes with the awarding of an Aquaculture Technician Diploma.
Aquaculture Transparency Set (1997)	Jasper S. Lee Interstate Publishers, Inc. P.O. Box 50 Danville, IL 61834-0050	Transparencies	Appropriate as an instructional aide for grade levels 9 – 12. Cost ~\$30.00.
Aquariology: the science of fish health management (1992)	Gratzek <i>et al.</i> Tetra Press Tetra/Second nature 3001 Commerce St. Blacksburg, VA 24060 Toll-Free: (800) 526-0650 Fax: (540)951- 5415 ISBN # 1-56465-105-3 http://www.tetra-fish.com/bookstore/aquasciencebkstr.html	Text	Author recommends text as appropriate for high school, college and veterinary school. Cost ~\$30.00

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
Building and Using Crab Pounds to Catch Peelers (1991)	B. Hines North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone:(919) 515-2454 Fax: (919) 515-7095	Unknown format	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG-BP-91-01 cost is free.
Caged Fish Production in Alabama (1997)	Michael Maser and David Cline Alabama Cooperative Extension System Auburn University Auburn, AL 36849 U.S.A. www.ag.auburn.edu/dept/faa/extprog.html Telephone: (334) 844-4786 Fax: (334) 844-9208	Three hole punched	General public is the target audience with adaptability to grade 8 and up.
Channel Catfish Farming Handbook (1990)	Craig Tucker and Edwin Robinson AVI Publishing Company Westport, CT ISBN # 0-442-31836-7	Text	Cost \$50-60
Clam Gardening: A Manual for the Small Scale Clam Operation in North Carolina (1991)	P. Kemp North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone:(919) 515-2454 Fax: (919) 515-7095	Manual	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG-91-02 cost is \$5.00
CRSP Research Reports (1997-99 continuing series)	PD/A CRSP Oregon State University 418 Snell Hall Corvallis, OR 97331-1643 http://www.orst.edu/dept/crsp/homepage.html	Reports	Appropriate for the general public and grades 12 and up. There is no cost for this publication.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
Design, Operation and Training Manual for an Intensive Culture Shrimp Hatchery (1993)	Treece and Fox Texas Sea Grant College Program Texas A & M University 1716 Briarcrest Suite 702 Bryan, TX 77802	Manual	Authors recommend as appropriate for grade levels 12 and up. Cost is \$20.00
Dynamics of Pond Aquaculture (1997)	Hillary Enga and Claude E. Boyd CRC Press LLC Headquarters 2000 NW Corporate Blvd Boca Raton, FL, USA 33431 http://www.crcpress.com .	Text	Authors recommend text as appropriate for the general public and grades 12 and up. Further recommendation for use as a college text for upper-division undergraduate students and graduate students. Cost ~ \$89.00
EdOP NET (1997-99 continuing series)	D. Clair and M. Niles PD/A CRSP Oregon State University 418 Snell Hall Corvallis, OR 97331-1643 http://www.orst.edu/dept/crsp/homepag e.html	Newsletter	Newsletter of aquaculture opportunities. Appropriate for the general public and grades 9 and up. There is no cost for this publication.
Explorations in Aquaculture: Vol. I Freshwater Resources for the Classroom	Fenna Hanes <i>et al</i> New England Board of Higher Education, Boston, MA.	Three hole punched	Hands-on aquaculture explorations for the classroom that are aligned with the National Science, Mathematics and Language Arts Standards. Useful for the integration of aquaculture with science and mathematics courses or as laboratory component of an aquaculture education program. Recirculating Aquaculture Chronological Assistance Letters (RASCALs) is a series of brief communiqués designed to assist development of an education program that uses a recirculating aquaculture system from concept to harvest.
Explorations in Aquaculture: Vol. II Marine Resources for the Classroom	Distributed by: Aquatic Eco-Systems Inc. 1767 Benbow Court, Appopka, FL 32703 Telephone: (407) 886-3939 www.aquaticecosystems.com		
RASCALs (2000)	Illinois-Indiana Sea Grant College Program, 1200 Forest Products Building, West Lafayette, IN 47907-1200	Fact Sheet	Fact Sheets for 15 species of freshwater fish and shrimp are valuable as reference materials for the aquaculture program and are recommended as appropriate for grades 9 and up. First copy of each fact sheet cost \$1.00; additional copies are \$.25 ea.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
Farming a New Fish...Hybrid Striped Bass (1995)	R. G. Hodson North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone:(919) 515-2454 Fax: (919) 515-7095	Manual and video	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG95-10. Manual only, \$10.00; Video only \$25.00; Manual and Video \$30.00.
Farming Marine Shrimp in Recirculating Freshwater Production Systems: A Practical Manual (1999)	Harbor Branch Oceanographic Institution , Inc. Aquaculture Division. 5600 U.S. 1 North, Ft. Pierce, FL 34946-7320 Toll Free: (800) 333-4264 x 298 mdavis@hboi.edu	Three hole punched Manual	Available free of charge, provides overview information regarding permitting, system establishment and management, health management and marketing for recirculating shrimp culture in Florida.
Fishes of Idaho (1978)	J. Simpson University of Idaho Press University of Idaho Press, 16 Brink Hall, Moscow, ID 83844-1107. Telephone: (208) 885-5939	Text	Suggested for use as a reference text for grades 12 and up. Cost is \$10.00.
Fundamentals of Aquaculture (1996)	James W. Avault AVA Publishing Co. Inc. P.O. Box 84060 Baton Rouge, LA 70884-4060	Text	Recommended as high school and college text. Cost \$60.00
Guide to the Analysis of Shrimp Farming (1999)	Griffin and Treece Texas Sea Grant College Program Texas A & M University 1716 Briarcrest Suite 702 Bryan, TX 77802	Software	Spread sheet for microcomputers. Author recommends appropriate for grade levels 12 and up. Cost is \$25.00
Handbook of Shrimp Diseases (1995)	Johnson Texas Sea Grant College Program Texas A & M University 1716 Briarcrest Suite 702 Bryan, TX 77802	Unknown format	Publication is valuable as a reference publication and management tool. Cost is \$2.00.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
How to Build a Crab Pot (1980)	J. Bahen North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone:(919) 515-2454 Fax: (919) 515-7095	Unknown format	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG-80-03 cost \$1.50
Improved Flow-Through Shedding Using Sand Filtration (1991)	W. Westcott North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone:(919) 515-2454 Fax: (919) 515-7095	Unknown format	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG-BP-91-02 cost is free.
Laboratory Manuals – Fundamentals of Aquaculture Advanced Aquaculture	E. Kaplan et al. Hofstra University 1000 Fulton Avenue Hempstead, NY 11549 1-800-HOFSTRA http://www.hofstra.edu/	Unpublished material	Authors recommend material as appropriate for under graduate and graduate students.
Laboratory Manual for the Culture of Panacid Shrimp Larvae (1993)	Treece and Yates Texas Sea Grant College Program Texas A & M University 1716 Briarcrest Suite 702 Bryan, TX 77802	Manual	Manual is available in English and Spanish. Author recommends appropriate for grade levels 12 and up. Cost is \$20.00
Laboratory Methods in Applied Aquaculture	John Scarpa and Mathew Landau Harbor Branch Oceanographic Institution, Inc. Aquaculture Division. 5600 U.S. 1 North, Ft. Pierce, FL 34946-7320 Toll Free: (800) 333-4264 x 298 jscarpa@hboi.edu	Unknown format	Author recommends that the material is appropriate for college level programs. Scheduled for publication in 2001 estimated cost ~\$25.00. Contact the author(s) for more information.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
Marine Aquaculture: How to Raise Saltwater fish in Your Classroom (2001)	Brandy M. Moran, Clifford A. Goudey and Alan L. Hankin MIT Sea Grant College Program E38 - 300 292 Main Street Cambridge, MA 02139 http://web.mit.edu/seagrant/ Telephone: (617) 253-7041 Fax: (617) 258-5730	Workbook	Curriculum including 6 units and 16 activities. There is a Teacher's Edition and a Student Workbook. The Teachers Edition and Student Workbook are available online on MIT Sea Grants web page. Downloadable versions are available through the education and publication links free of charge. Printed copies can be ordered online at the MIT Sea Grants publication site or by calling 617-253-7092. The charge for the printed material is \$15.
Marketing Options for Small Scale Aquaculture Producers (1996)	David Cline Alabama Cooperative Extension System Auburn University Auburn, AL 36849 U.S.A. www.ag.auburn.edu/dept/faa/extprog.html Telephone: (334) 844-4786 FAX: (334) 844-9208	Three hole punched	General public is the target audience with adaptability to grade 8 and up.
Pond (software) (1997 updated regularly)	J. Bolte and S. Nath PD/A CRSP Oregon State University 418 Snell Hall Corvallis, OR 97331-1643 http://www.orst.edu/dept/crsp/homepage.html	Software	Decision and support software for aquaculture farms and student modeling. Recommended as appropriate for the general public and grade 12 and up. There is no cost for this software.
Pond Fertilization: Ecological Approach and Practical Application (1998)	C. Knudsen PD/A CRSP Oregon State University 418 Snell Hall Corvallis, OR 97331-1643 http://www.orst.edu/dept/crsp/homepage.html	Text	Text and manual are recommended as appropriate for the general public and advanced students grades 9 and up. There is no cost for this publication.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
Practical Manual for Semi-intensive Commercial Production of Marine Shrimp (1991 English, 1993 Spanish)	Villalon Texas Sea Grant College Program Texas A & M University 1716 Briarcrest Suite 702 Bryan, TX 77802	Manual	Manual is available in English and Spanish. Author recommends appropriate for grade levels 12 and up. Cost is \$15.00
Shedding Soft Crabs in a Closed Well-Water System (1988)	North Carolina Sea Grant North Carolina State University 1911 Building Room 100B Box 8605 Raleigh, NC 27695-8605 Telephone:(919) 515-2454 Fax: (919) 515-7095	Unknown format	Extension / education material developed through the North Carolina Sea Grant Program. Publication # UNC-SG-BP-88-01 cost is free.
Something Fishy (1991)	Illinois-Indiana Sea Grant College Program, 1200 Forest Products Building, West Lafayette, IN 47907-1200	Video	15 minute video that covers topics such as cage construction, stocking, feeding, harvesting, transport, marketing, potential problems and choosing the right pond. Recommended as appropriate for grades 9 and up. Publication # V-AS-18 cost is \$15.00
Testing Dissolved Oxygen Using the Winkler Method (1997)	Illinois-Indiana Sea Grant College Program, 1200 Forest Products Building, West Lafayette, IN 47907-1200	Unknown format	Recommended as appropriate for grades 9 and up. Publication # CD-AS-1 cost is \$15.00 for instructors and \$25.00 for the general public.
The "Stand-Alone" undergraduate aquaculture class	Mathew Landau Department of Wildlife and Fisheries Mississippi State University Box 9690 Mississippi State, MS 39762 Volume 30 (2), June 1999 http://www.was.org/	Article	Article to be published in World Aquaculture. Author recommends appropriate for college level programs.
The Role of Aquaculture in the Indian River Lagoon: Environmental Education Programs for Middle and High School Students (1998-1999)	Megan Davis-Hodgkin and D. Vaughan Harbor Branch Oceanographic Institution, Inc. Aquaculture Division. 5600 U.S. 1 North, Ft. Pierce, FL 34946-7320 Toll Free: (800) 333-4264 x 298 mdavis@hboi.edu	Education program supplemental material	Materials are supplemental to an aquaculture/environmental education program designed to provide exposure to aquaculture in its various forms in Florida. Offered to educators in St. Lucie and Martin Counties, FL. Program relies on expertise of Harbor Branch Staff (ACTED program) and the Council 5 volume aquaculture curriculum (1992). Very comprehensive designed to address the Florida Sunshine State Standards for middle and high school students.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
The World Wide Web "Adult Education in Cyberspace" (1997)	Illinois-Indiana Sea Grant College Program, 1200 Forest Products Building, West Lafayette, IN 47907-1200	Unknown format	Describes the Web as it applies to delivering information to learners across the world. Recommended as appropriate for grades 9 and up. Publication # AS-510 is 8 pages and costs \$1.00
USDA CSREES Center for Tropical & Subtropical Aquaculture (CTSA) Fact Sheets and Publications	Center for Tropical & Subtropical Aquaculture Dr. Cheng-sheng Lee, Director The Oceanic Institute 41-202 Kalanainaole Highway Waimanalo, HI 96795-1820 Telephone: (808) 259-3107 Email: Cheng-Shenglee@compuserve.com	Fact sheet	Fact sheets, progress reports, technical bulletins and manuals that are available on line in pdf format or hard copy.
USDA CSREES North Central Regional Aquaculture Center (NCRAC) Fact Sheets and Publications	North-Central Regional Aquaculture Center Dr. Ted R. Batterson, Director Room 13, Natural Resources Building Michigan State University East Lansing, MI 48824-1222 Email: batters2@pilot.msu.edu	Fact sheet	Fact sheets, progress reports, technical bulletins and manuals that are available on line in pdf format or hard copy.
USDA CSREES Northeastern Regional Aquaculture Center (NRAC) Fact Sheets and Publications	Northeastern Regional Aquaculture Center www.umassd.edu/specialprograms/nrac 285 Old Westport Road, Violet Bldg. University of Massachusetts Dartmouth Dartmouth, MA 02747 Telephone: (508) 999-8157	Fact sheet	Fact sheets that are available in pdf format form the NRAC web page. Fact sheets cover a wide range of topics including species, production methods, technology, marketing, disease treatment and processing.
USDA CSREES Southern Regional Aquaculture Center (SRAC) Fact Sheets and Publications	Southern Regional Aquaculture Center www.msstate.edu/dept/srac/fslist.htm 127 Experiment Station Road P.O. Box 197 Stoneville, MS 38776 Telephone: (662) 686-3285 Fax:: (662) 686-3569	Fact sheet	More than 100 fact sheets that are available in pdf format form the SRAC web page. Fact sheets cover a wide range of topics including species, production methods, technology, marketing, disease treatment and processing.

Appendix A: Additional aquaculture education material identified but not evaluated by the *Aquaculture Curricula Resource Guide*.

Program/Title (year)	Author / Source	Format	Comments
USDA CSREES Western Regional Aquaculture Center (WRAC) Fact Sheets and Publications	Western Regional Aquaculture Center Dr. Kenneth Chew, Director University of Washington Fisheries Science Seattle, WA 98195-7980 Email: kchew@fish.washington.edu	Fact sheet	Fact sheets, progress reports, technical bulletins and manuals that are available on line in pdf format or hard copy.
Vermont Department of Fish and Wildlife Fish Culture Training Workshops	Lilla Stutz-Lumbra Vermont Department of Fish and Wildlife Ed Weed Fish Culture Station 14 Bell Hill Road Grand Isle, VT 05458 Telephone: (802) 372-3171	Training program Workshop manuals	Series of workshops and accompanying training manuals. Program consists of three workshop sessions that last two weeks each. Topics covered include, Session 1. Fish pathogens, including bacterial, viral, parasitic and environmental (with emphasis on trout and salmon). Session 2. Fish culture requirements and facility design, fish culture operations, fish nutrition and feeding. Session 3. Broodstock management techniques, egg development and incubation, coolwater culture and fish transportation techniques.
Water Quality in Warm Water Fish Ponds (1979 and 1990 update)	Claude E. Boyd Auburn University Auburn, AL 36849 U.S.A. www.ag.auburn.edu/dept/faa/extprog.html Telephone: (334) 844-4786 Fax: (334) 844-9208	Text	This publication is out of print. However, there are a number of aquaculture titles available written by this author. Most target pond aquaculture and water quality management. Good text and reference books for a comprehensive aquaculture education program. Search any online book provider for the author and title.
Wildlife Management (1999)	Statzenbaker, Scheil, Swan, Lee and Mattics Interstate Publishers, Inc. P.O. Box 50 Danville, IL 61834-0050	Text	Appropriate for grade levels 9 – 12. Cost ~\$40.00.

Appendix B:

Letter and survey form developed to collect information about currently used aquaculture curricula.

Appendix B: Letter and survey form developed to collect information about currently used aquaculture curricula.

January 23, 1999

Greetings,

In effort to increase aquaculture education opportunities and to facilitate access to existing aquaculture educational materials, the USDA Northeastern Regional Aquaculture Center is supporting a collaborative effort of the Massachusetts Department of Food and Agriculture (MADFA) and the New England Board of Higher Education (NEBHE) titled "*Aquaculture Curricula Resource Guide Publication and Distribution*". The development of the Resource Guide project builds on an ongoing, similarly collaborative, project titled the New England Aquaculture Educators Network "AQUA" that was initiated by NEBHE during 199?. With partial support from the National Science Foundation, the "AQUA" project has provided equipment , ongoing technical support and project development assistance to aquaculture education alliances throughout the six New England states. To that end, the "AQUA" project has laid the ground work for the Resource Guide project.

Among the numerous objectives of the *Aquaculture Curricula Resource Guide Publication and Distribution* project, the identification of existing national and international aquaculture curricula and educational materials is perhaps the most important. Considering that it is the primary intent of this project to produce a curricula resource guide that is comprehensive and user friendly, the impact of this project will be directly related to the successful identification of educational materials have been developed for elementary, traditional secondary, secondary vocational technical and agricultural schools.

With the above in mind and in the interest of expanding the availability and exposure of your aquaculture educational materials or those that you may be aware of, please respond to the enclosed questionnaire by (month x,) 1999.

If you have any questions regarding the "*Aquaculture Curricula Resource Guide Publication and Distribution*" project, please do not hesitate to contact either myself at the MA DFA (617-727-9800 x238) or Fenna Hanes at NEBHE (617-357-9620 x136). We look forward to your response and thank you in advance for your assistance on this project.

Sincerely,

Scott J. Soares
Aquaculture Coordinator
MA DFA

Fenna Hanes
Project Director
NEBHE

Appendix B: Letter and survey form developed to collect information about currently used aquaculture curricula.

Please mark your response in the space provided for the following questions.

Please use the accompanying matrix to describe the aquaculture curricula and/or educational materials that you use or are familiar with.

Using the enclosed postage paid envelope, Please return your completed questionnaire to:

Scott J. Soares
 Aquaculture Coordinator
 Massachusetts Department of Food and Agriculture
 100 Cambridge St rm 2103
 Boston, MA 02202

Name: _____

Address: _____

Phone/email/internet: _____

As a contributor to this publication you have the option of being cited as a contact for the aquaculture curricula and/or educational materials references that you provide.

Would you like to be listed as a contact for the references that you provide? ___ YES ___ NO

How often are you contacted for aquaculture educational materials

(Please check one)

___ never ___ <6 times annually ___ monthly ___ weekly ___ daily

What education levels contact you for aquaculture educational materials?

(Please check all that apply)

___ grades K-8 ___ grades 9-12 ___ grades12+ ___ general public

___ others (please describe)

Of the education levels that contact you, who contacts you the most?

(Please check all that apply)

___ grades K-8 ___ grades 9-12 ___ grades12+ ___ general public

What type of educational materials are requested?

(check all that apply)

___ fact sheets ___ individual lesson plans ___ audio/visual aids ___ full curricula

___ other (please describe)

Appendix B: Letter and survey form developed to collect information about currently used aquaculture curricula.

Aquaculture Curricula / Education Material Description Matrix

Curriculum or Material Title	Developer(s)/author(s)	Publication Date	Source/Publisher	Cost	Suggested Education Level

Appendix C:

**Information on the aquaculture curricula evaluated in the
*Aquaculture Curricula Resource Guide.***

Appendix C: Information on the aquaculture curricula evaluated in the *Aquaculture Curricula Resource Guide*.

Author/ Editor	Title	Publisher	Copyright	Format	Address	Cost
Belusz, Lawrence C.	<i>Instructor Lesson Plans for Mathematical Concepts and Measurement of Fish Performance and Water Management in Classroom Aquaculture</i>	Aquatic Eco-Systems	1996	3 hole punch; loose leaf note book (172 pp.)	Aquatic Eco-Systems Inc. 1767 Benbow Court, Apopka, FL 32703 (407) 886-3939 www.aquaticecosystems.com	\$159.00
Crochet, Greg & Mike Murphy	<i>Mississippi Curriculum Framework for Aquaculture</i>	Mississippi Department of Education	1998	3 hole punch; loose leaf note book (download in pdf format) (112 pp.)	Research and Curriculum Unit for Workforce Development Vocational and Technical Education Mississippi State University P. O. Drawer DX Mississippi State, MS 39762 www.msstate.edu/Dept/RCU/pdf/98se c/secaquaculture.pdf	free
Foster, John R.	<i>Practical Aquaculture: A High School Curriculum Based on Hands-on Experiential Learning</i>	State University of New York / Cobleskill	1998	soft cover manual plastic spiral bound (316 pp.)	Fisheries & Aquaculture State University of New York Cobleskill, NY 12043	\$25.00
Hudson, C. Jordan	<i>Aquaculture Infusion Units</i>	Commonwealth of Virginia, Virginia Department of Education, Office of Vocational and Adult Education Services, Agricultural Education,	1997	3 hole punch; loose leaf note book (320 pp.)	Commonwealth of Virginia Virginia Department of Education Office of Vocational and Adult Education Services Agricultural Education Richmond, VA 23218-2120 (804) 225-2847 www.pen.k12.va.us/go/Voc_Ed/	\$24.00

Appendix C: Information on the aquaculture curricula evaluated in the *Aquaculture Curricula Resource Guide*.

Author/ Editor	Title	Publisher	Copyright	Format	Address	Cost
Landau, Matthew	<i>Introduction to Aquaculture</i>	John Wiley & Sons, Inc.	1992	hard cover text (440 pp.)	John Wiley & Sons Inc. One Wiley Drive Somerset, NJ 08875 (800) 225-5945 www.wiley.com ISBN:0-471-61146-8	\$77.95
Lee, Jasper and M. Newman	<i>Aquaculture: An Introduction 2nd Edition</i>	Interstate Publishers Inc., Danville, IL	1997	hard cover text (518 pp.)	Interstate Publishers, Inc. 510 North Vermilion St PO Box 50 Danville, IL 61834-0050 (800) 843-4774 www.ippinc.com/ ISBN:0-8134-3084-4	\$40.00
Lee, Jasper and Associates Ed.	<i>Aquaculture How To Series</i>	National Council for Agricultural Education	1999	3 hole punch; loose leaf note book (241 pp.)	The National Council for Agricultural Education Suite 400 1410 King St Alexandria, VA 22314 (800) 772-0939 www.teamaged.org/aquaculture/index.htm	free
Parker, Rick	<i>Aquaculture Science</i>	Delmar Publishers	1995	hard cover text, soft cover lab manual, soft cover teacher guide (660 pp.) (*computerized test bank, teachers lab manual and resource manual also available for additional cost although not included in this review)	Delmar Publishers 3 Columbia Circle Box 15015 Albany, NY 12212-5015 (800) 998-7498 www.delmar.com ISBN:0-8273-6454-7	\$80.00

Appendix C: Information on the aquaculture curricula evaluated in the *Aquaculture Curricula Resource Guide*.

Author/ Editor	Title	Publisher	Copyright	Format	Address	Cost
Rice, Michael A.	<i>Laboratory Manual Shellfish Aquaculture</i>	Department of Fisheries, Animal and Veterinary Science, University of Rhode Island	1998	soft cover manual plastic spiral bound (69 pp.)	University of Rhode Island Campus Copy & Design Memorial Union Bldg. Kingston, RI 02881 (401)874-2943 www.uri.edu/cels/favs/mr.html	\$10.00
Swann , LaDonn, J. Brown, S. Katz, R. Merzdorf	<i>Getting Started in Freshwater Aquaculture: an interactive learning experience</i>	Purdue University / Illinois-Indiana Sea Grant	1998	soft cover manual to accompany CD-ROM (208 pp.)	Illinois-Indiana Sea Grant College Program Department of Animal Sciences Purdue University West Lafayette, IN 47907-1026 ISBN:0-931682-71-1	\$60.00
The National Council for Agricultural Education	<i>Aquaculture Curriculum Guide: 5 Module Set</i>	The National Council for Agricultural Education	1992	5 volumes 3 hole punch; loose leaf note books (513 pp.)	The National Council for Agricultural Education Suite 400 1410 King Street Alexandria, VA 22314 (800) 772-0939 www.teamaged.org/aquaculture/index.htm	\$56.00

Appendix C: Information on the aquaculture curricula evaluated in the *Aquaculture Curricula Resource Guide*.

Author/ Editor	Title	Publisher	Copyright	Format	Address	Cost
Walker, Susan S.	<i>Aquaculture: Second Edition</i>	The Multistate Academic Vocational Curriculum Consortium, Inc.	1996	3 hole punch; loose leaf note book (588 pp.)	Multistate Academic & Vocational Curriculum Consortium, Inc. 1500 West Seventh Stillwater, OK 74074-4364 (800) 654-3988 www.mavcc.org	\$132.50
White, Susan ME/NH Sea Grant	<i>Aquaculture in Maine: A curriculum guide for secondary school teachers</i>	The Aquaculture Education Coalition, ME Dept. of Education	1996	3 hole punch; loose leaf note book (231 pp.)	Maine Sea Grant College Program 20 Coburn Hall University of Maine Orono, ME 04469 (207) 581-1440 www.seagrant.unh.edu/pubs.htm	\$25.00

Appendix D:

Work sheet used for curriculum analysis.

Appendix D: Work sheet used for curriculum analysis.

Aquaculture Curriculum Resource Guide Publication and Distribution Project Curriculum Analysis Worksheet

Title _____
 Author _____
 Publisher _____
 Copyright _____
 Evaluator _____

Please score your review using the following rating schedule:

- 3 - provides outstanding coverage of the item
- 2 - provides acceptable/average coverage of the item
- 1 - provides minimum coverage of the item
- 0 - does not address the item or item is not applicable

I. Content: *Coverage and Quality*

- _____ A. Reflects the Content Standards of the National Science Education Standards or equivalent state documents
- _____ B. Presents scope and sequence in a logical manner.
- _____ C. Contains a volume of content that is not excessive for its stated purpose.
- _____ D. Achieves a balance between depth and breadth of coverage.
- _____ E. Is scientifically accurate.
- _____ F. Represents science as dynamic, testable and verifiable.
- _____ G. Makes interdisciplinary connections.
- _____ H. Applies science and technology to everyday, real-world issues and decisions.
- _____ I. Connects topics to relevant social issues and career opportunities.
- _____ J. Is unbiased in terms of culture, gender, or race.
- _____ K. Is scientifically current.

II. Content: *Organization and Structure*

- _____ A. Emphasizes active student learning.
- _____ B. Uses concrete examples to introduce abstract concepts.
- _____ C. Builds upon student's prior knowledge.
- _____ D. Emphasizes conceptual understanding rather than rote learning.
- _____ E. Provides experiences that build reasoning and analytical skills.
- _____ F. Contains open-ended problem-solving investigations.
- _____ G. Includes opportunities to use a variety of science process skills.
- _____ H. Requires using a wide assortment of analytical instruments and tools.
- _____ I. Includes a variety of individual, group, and class activities.
- _____ J. Encourages dialogue, collaboration and reflection.
- _____ K. Incorporates linkages between science and non science disciplines.

Appendix D: Work sheet used for curriculum analysis.

III. Content: *Format and Readability*

- _____ A. Reading level is appropriate for intended student population.
- _____ B. Interesting, flowing narrative that can stimulate and maintain student interest.
- _____ C. Print size and typeface ensure legibility.
- _____ D. Material is well organized
- _____ E. Identifies the learning objectives for each section.
- _____ F. Contains clear and concise headings that direct learner to the major concepts.
- _____ G. Uses accurate high quality illustrations that enhance student understanding.
- _____ H. Identifies safety precautions.
- _____ I. Provides clear instructions for using tools, equipment, and materials.
- _____ J. Includes learning and study tips.
- _____ K. Gives ideas for supplemental learning opportunities and lists resources.
- _____ L. Reflects the diversity of society through activities, language, and illustrations.

IV. Assessment

- _____ A. Connects evaluation instrument to learning objectives.
- _____ B. Emphasizes problem solving and real-world applications.
- _____ C. Embeds assessment throughout the instructional program.
- _____ D. Includes a variety of assessment strategies.
- _____ E. Assesses development of processing skills.

V. Teacher Resources

- _____ A. Provides background information about content.
- _____ B. Suggests lesson sequences and instructional strategies.
- _____ C. Offers ideas for adapting materials to different audiences.
- _____ D. Includes suggestions for using appropriate instructional technology.
- _____ E. Identifies health and safety concerns.
- _____ F. Contains a master material and equipment list.
- _____ G. Includes instructional aids (e.g. transparencies, slides, CD ROM, web pages, etc)

VI. Comments

Appendix E:

Individual assessment for each aquaculture curriculum evaluated.

Appendix E. Individual assessment for each aquaculture curriculum evaluated.

Author		Belusz, Lawrence C.		Crochet, Greg and M. Murphy		Foster, John R.	
		Average	STDEV	Average	STDEV	Average	STDEV
I. Content: Coverage and Quality							
A.	Reflects the Content Standards of the National Science Education Standards or equivalent state documents	0.0	0.0	2.8	0.3	0.0	0.0
B.	Presents scope and sequence in a logical manner	2.0	0.5	2.7	0.3	2.2	0.3
C.	Contains a volume of content that is not excessive for its stated purpose	2.8	0.3	2.2	0.3	2.7	0.3
D.	Achieves a balance between depth and breadth of coverage	2.3	0.3	1.0	0.5	2.5	0.5
E.	Is scientifically accurate	2.3	0.3	0.0	0.0	2.7	0.3
F.	Represents science as dynamic, testable and verifiable	3.0	0.0	1.8	0.8	1.8	0.3
G.	Makes interdisciplinary connections	1.8	0.3	2.2	0.3	1.8	0.3
H.	Applies science and technology to everyday, real-world issues and decisions	2.8	0.3	2.5	0.5	2.2	0.3
I.	Connects topics to relevant social issues and career opportunities	1.0	0.0	2.8	0.3	0.5	0.5
J.	Is unbiased in terms of culture, gender, or race	0.3	0.6	0.0	0.0	2.0	0.0
K.	Is scientifically current	2.3	0.6	0.0	0.0	1.8	0.3
Section I Mean and STDEV		1.9	0.1	1.6	0.2	1.8	0.2
II. Content: Organization and Structure							
A.	Emphasizes active student learning	3.0	0.0	2.7	0.6	2.2	0.3
B.	Uses concrete examples to introduce abstract concepts	2.8	0.3	0.0	0.0	2.3	0.3
C.	Builds upon student's prior knowledge	2.7	0.3	2.8	0.3	2.2	0.3
D.	Emphasizes conceptual understanding rather than rote learning	3.0	0.0	2.3	0.3	2.2	0.3
E.	Provides experiences that build reasoning and analytical skills	3.0	0.0	2.2	0.3	2.3	0.3
F.	Contains open-ended problem-solving investigations	3.0	0.0	2.2	0.3	2.3	0.3
G.	Includes opportunities to use a variety of science process skills	2.7	0.3	2.3	0.3	2.2	0.3
H.	Requires using a wide assortment of analytical instruments and tools	2.7	0.3	2.8	0.3	1.8	0.3
I.	Includes a variety of individual, group, and class activities	3.0	0.0	3.0	0.0	2.3	0.3
J.	Encourages dialogue, collaboration and reflection	2.8	0.3	2.5	0.5	2.3	0.3
K.	Incorporates linkages between science and non science disciplines	1.5	0.0	2.2	0.3	1.3	0.3
Section II Mean and STDEV		2.7	0.5	2.3	0.8	0.4	0.0
III. Content: Format and Readability							
A.	Reading level is appropriate for intended student population	2.3	0.3	0.0	0.0	2.3	0.3
B.	Interesting, flowing narrative that can stimulate and maintain student interest	2.0	0.0	0.0	0.0	2.0	0.0
C.	Print size and typeface ensure legibility	2.7	0.3	2.2	0.3	2.0	0.0
D.	Material is well organized	2.3	0.3	2.8	0.3	2.3	0.3
E.	Identifies the learning objectives for each section	3.0	0.0	3.0	0.0	1.7	0.3
F.	Contains clear and concise headings that direct learner to the major concepts	2.8	0.3	2.3	0.3	2.2	0.3
G.	Uses accurate high quality illustrations that enhance student understanding	0.7	0.6	0.0	0.0	1.0	0.5
H.	Identifies safety precautions	1.0	0.5	2.8	0.3	1.2	0.3
I.	Provides clear instructions for using tools, equipment, and materials	1.7	0.6	0.0	0.0	0.8	0.3
J.	Includes learning and study tips	1.7	0.3	0.0	0.0	1.3	0.3
K.	Gives ideas for supplemental learning opportunities and lists resources	0.7	0.6	2.0	0.5	2.2	0.6
L.	Reflects the diversity of society through activities, language, and illustrations	0.0	0.0	0.0	0.0	0.2	0.3
Section III Mean and STDEV		1.7	0.1	1.3	0.1	0.7	0.1
IV. Assessment							
A.	Connects evaluation instrument to learning objectives	3.0	0.0	3.0	0.0	1.7	0.6
B.	Emphasizes problem solving and real-world applications	3.0	0.0	2.5	0.5	2.8	0.3
C.	Embeds assessment throughout the instructional program	3.0	0.0	2.7	0.3	1.5	0.5
D.	Includes a variety of assessment strategies	2.7	0.3	0.8	0.3	0.8	0.8
E.	Assesses development of processing skills	2.5	0.5	1.0	0.0	1.2	0.3
Section IV Mean and STDEV		2.8	0.1	2.0	0.1	0.8	0.3
V. Teacher Resources							
A.	Provides background information about content	2.3	0.3	0.3	0.6	2.3	0.3
B.	Suggests lesson sequences and instructional strategies	2.2	0.3	2.8	0.3	1.2	0.3
C.	Offers ideas for adapting materials to different audiences	0.7	0.6	1.3	0.6	0.2	0.3
D.	Includes suggestions for using appropriate instructional technology	2.5	0.0	0.8	0.3	0.5	0.5
E.	Identifies health and safety concerns	1.3	0.3	2.7	0.3	1.0	0.5
F.	Contains a master material and equipment list	3.0	0.0	3.0	0.0	0.2	0.3
G.	Includes instructional aids (e.g. transparencies, slides, CD ROM, web pages, etc)	2.0	0.5	0.0	0.0	0.3	0.3
Section V Mean and STDEV		2.0	0.1	1.6	0.1	0.8	0.2

Appendix E. Individual assessment for each aquaculture curriculum evaluated.

Author		Hudson, C. Jordan		Landau, Mathew		Lee, Jasper and M. Newman	
		Average	STDEV	Average	STDEV	Average	STDEV
I. Content: Coverage and Quality							
A.	Reflects the Content Standards of the National Science Education Standards or equivalent state documents	0.3	0.6	0.8	1.4	0.3	0.6
B.	Presents scope and sequence in a logical manner	2.2	0.3	2.3	0.6	1.8	0.3
C.	Contains a volume of content that is not excessive for its stated purpose	2.2	0.3	2.7	0.6	2.0	0.0
D.	Achieves a balance between depth and breadth of coverage	1.7	0.3	2.5	0.5	1.5	0.5
E.	Is scientifically accurate	1.7	0.3	1.8	1.6	0.8	0.8
F.	Represents science as dynamic, testable and verifiable	1.0	0.0	1.7	0.6	1.3	0.3
G.	Makes interdisciplinary connections	2.3	0.3	2.5	0.5	2.0	0.0
H.	Applies science and technology to everyday, real-world issues and decisions	2.3	0.6	1.5	1.3	1.7	0.6
I.	Connects topics to relevant social issues and career opportunities	1.3	0.3	1.2	1.0	2.2	0.3
J.	Is unbiased in terms of culture, gender, or race	2.0	0.0	1.5	1.3	1.8	0.3
K.	Is scientifically current	1.5	0.5	2.2	0.3	1.3	0.3
Section I Mean and STDEV		1.7	0.2	1.9	0.3	1.5	0.2
II. Content: Organization and Structure							
A.	Emphasizes active student learning	1.7	0.3	1.2	0.3	2.0	0.5
B.	Uses concrete examples to introduce abstract concepts	1.7	0.3	2.2	0.3	1.7	0.6
C.	Builds upon student's prior knowledge	2.3	0.3	1.7	0.3	2.0	0.5
D.	Emphasizes conceptual understanding rather than rote learning	1.8	0.3	1.8	0.3	1.7	0.6
E.	Provides experiences that build reasoning and analytical skills	2.2	0.3	1.3	0.6	1.8	0.8
F.	Contains open-ended problem-solving investigations	2.0	0.5	0.8	0.8	2.3	1.2
G.	Includes opportunities to use a variety of science process skills	1.8	0.3	1.2	0.3	1.3	0.6
H.	Requires using a wide assortment of analytical instruments and tools	1.3	0.3	0.7	0.6	1.2	0.3
I.	Includes a variety of individual, group, and class activities	1.8	0.3	0.3	0.6	1.5	0.9
J.	Encourages dialogue, collaboration and reflection	2.3	0.3	0.7	1.2	1.8	0.8
K.	Incorporates linkages between science and non science disciplines	1.8	0.3	1.7	0.3	1.7	0.6
Section II Mean and STDEV		1.9	0.4	1.2	0.7	1.7	0.7
III. Content: Format and Readability							
A.	Reading level is appropriate for intended student population	2.5	0.5	2.7	0.3	0.5	0.9
B.	Interesting, flowing narrative that can stimulate and maintain student interest	1.7	0.6	2.0	0.0	1.7	0.8
C.	Print size and typeface ensure legibility	2.8	0.3	2.8	0.3	2.7	0.6
D.	Material is well organized	2.7	0.3	2.8	0.3	2.2	0.3
E.	Identifies the learning objectives for each section	3.0	0.0	0.0	0.0	2.7	0.6
F.	Contains clear and concise headings that direct learner to the major concepts	2.8	0.3	2.0	0.0	2.7	0.6
G.	Uses accurate high quality illustrations that enhance student understanding	2.2	0.3	2.3	0.3	0.8	0.8
H.	Identifies safety precautions	0.3	0.6	0.3	0.6	1.0	0.9
I.	Provides clear instructions for using tools, equipment, and materials	0.8	0.3	0.0	0.0	1.3	1.2
J.	Includes learning and study tips	1.3	0.3	0.0	0.0	1.8	1.0
K.	Gives ideas for supplemental learning opportunities and lists resources	2.2	0.6	2.8	0.3	1.8	0.8
L.	Reflects the diversity of society through activities, language, and illustrations	0.0	0.0	1.2	0.3	1.7	0.6
Section III Mean and STDEV		1.9	0.2	1.6	0.1	1.7	0.3
IV. Assessment							
A.	Connects evaluation instrument to learning objectives	1.7	0.8	0.0	0.0	2.2	1.0
B.	Emphasizes problem solving and real-world applications	2.5	0.5	1.2	0.3	1.8	0.8
C.	Embeds assessment throughout the instructional program	1.7	0.3	0.0	0.0	1.8	1.0
D.	Includes a variety of assessment strategies	2.2	0.3	0.0	0.0	1.7	0.6
E.	Assesses development of processing skills	0.3	0.6	0.0	0.0	1.0	1.0
Section IV Mean and STDEV		1.7	0.4	0.2	0.1	1.7	0.7
V. Teacher Resources							
A.	Provides background information about content	1.7	0.3	2.7	0.3	1.3	0.6
B.	Suggests lesson sequences and instructional strategies	1.8	0.3	1.2	0.3	0.7	0.6
C.	Offers ideas for adapting materials to different audiences	0.0	0.0	0.3	0.6	0.7	0.6
D.	Includes suggestions for using appropriate instructional technology	1.5	0.5	0.3	0.6	0.7	0.6
E.	Identifies health and safety concerns	0.7	0.6	0.0	0.0	1.0	1.0
F.	Contains a master material and equipment list	0.0	0.0	0.0	0.0	0.3	0.6
G.	Includes instructional aids (e.g. transparencies, slides, CD ROM, web pages, etc)	2.8	0.3	0.0	0.0	0.3	0.6
Section V Mean and STDEV		1.2	0.1	0.6	0.2	0.7	0.4

Appendix E. Individual assessment for each aquaculture curriculum evaluated.

Author		Lee, Jasper and Associates Ed.		Parker, Rick		Rice, Michael A.	
		Average	STDEV	Average	STDEV	Average	STDEV
I. Content: Coverage and Quality							
A.	Reflects the Content Standards of the National Science Education Standards or equivalent state documents	1.7	0.3	0.0	0.0	0.0	0.0
B.	Presents scope and sequence in a logical manner	1.3	0.3	2.0	0.5	1.5	0.5
C.	Contains a volume of content that is not excessive for its stated purpose	2.0	0.0	3.0	0.0	2.5	0.5
D.	Achieves a balance between depth and breadth of coverage	1.7	0.3	2.7	0.3	1.8	0.8
E.	Is scientifically accurate	1.5	0.5	2.2	1.0	2.7	0.6
F.	Represents science as dynamic, testable and verifiable	2.2	0.3	2.2	0.3	2.5	0.5
G.	Makes interdisciplinary connections	2.2	0.3	2.3	0.3	1.3	0.3
H.	Applies science and technology to everyday, real-world issues and decisions	2.7	0.3	2.7	0.6	2.3	0.3
I.	Connects topics to relevant social issues and career opportunities	2.0	0.0	2.8	0.3	0.0	0.0
J.	Is unbiased in terms of culture, gender, or race	1.8	0.3	2.3	0.3	2.0	0.0
K.	Is scientifically current	2.0	0.0	1.5	0.7	2.8	0.3
Section I Mean and STDEV		1.9	0.1	2.2	0.2	1.8	0.2
II. Content: Organization and Structure							
A.	Emphasizes active student learning	2.7	0.3	2.8	0.3	2.7	0.6
B.	Uses concrete examples to introduce abstract concepts	2.3	0.3	2.7	0.3	2.8	0.3
C.	Builds upon student's prior knowledge	2.3	0.3	2.2	0.3	2.5	0.5
D.	Emphasizes conceptual understanding rather than rote learning	2.3	0.3	2.2	0.3	3.0	0.0
E.	Provides experiences that build reasoning and analytical skills	2.5	0.0	2.8	0.3	2.5	0.5
F.	Contains open-ended problem-solving investigations	2.2	0.3	2.7	0.3	2.5	0.5
G.	Includes opportunities to use a variety of science process skills	2.5	0.0	2.2	0.3	2.8	0.3
H.	Requires using a wide assortment of analytical instruments and tools	3.0	0.0	2.3	0.3	3.0	0.0
I.	Includes a variety of individual, group, and class activities	3.0	0.0	2.3	0.3	2.7	0.3
J.	Encourages dialogue, collaboration and reflection	2.5	0.5	2.5	0.0	2.5	0.5
K.	Incorporates linkages between science and non science disciplines	2.0	0.0	2.8	0.3	1.2	0.6
Section II Mean and STDEV		2.5	0.4	2.5	0.4	2.6	0.3
III. Content: Format and Readability							
A.	Reading level is appropriate for intended student population	2.2	0.3	3.0	0.0	2.3	0.3
B.	Interesting, flowing narrative that can stimulate and maintain student interest	2.0	0.0	2.3	0.6	1.7	0.6
C.	Print size and typeface ensure legibility	2.3	0.6	3.0	0.0	2.0	0.0
D.	Material is well organized	1.7	0.3	2.3	0.3	1.7	0.6
E.	Identifies the learning objectives for each section	2.8	0.3	2.7	0.6	2.3	0.6
F.	Contains clear and concise headings that direct learner to the major concepts	2.5	0.5	3.0	0.0	1.7	0.6
G.	Uses accurate high quality illustrations that enhance student understanding	2.0	0.0	2.0	0.5	1.2	0.3
H.	Identifies safety precautions	3.0	0.0	1.3	0.3	0.7	0.6
I.	Provides clear instructions for using tools, equipment, and materials	1.8	0.3	1.5	0.5	2.0	0.0
J.	Includes learning and study tips	2.2	0.3	2.5	0.5	0.7	0.3
K.	Gives ideas for supplemental learning opportunities and lists resources	3.0	0.0	3.0	0.0	2.8	0.3
L.	Reflects the diversity of society through activities, language, and illustrations	0.7	0.6	1.8	0.3	0.0	0.0
Section III Mean and STDEV		2.2	0.2	2.4	0.1	1.6	0.3
IV. Assessment							
A.	Connects evaluation instrument to learning objectives	1.2	0.3	2.7	0.3	0.3	0.6
B.	Emphasizes problem solving and real-world applications	2.3	0.3	2.8	0.3	2.7	0.6
C.	Embeds assessment throughout the instructional program	1.5	0.5	2.2	0.3	1.3	0.3
D.	Includes a variety of assessment strategies	0.7	0.6	2.2	0.3	0.0	0.0
E.	Assesses development of processing skills	1.2	0.3	2.2	0.3	0.0	0.0
Section IV Mean and STDEV		1.4	0.3	2.4	0.1	0.9	0.3
V. Teacher Resources							
A.	Provides background information about content	1.3	0.3	2.0	0.5	2.0	0.0
B.	Suggests lesson sequences and instructional strategies	1.3	0.3	2.3	0.3	0.0	0.0
C.	Offers ideas for adapting materials to different audiences	1.2	0.3	0.7	0.8	0.0	0.0
D.	Includes suggestions for using appropriate instructional technology	1.8	0.3	1.8	0.3	0.0	0.0
E.	Identifies health and safety concerns	2.3	0.3	1.3	0.6	1.2	0.3
F.	Contains a master material and equipment list	2.5	0.0	2.0	0.0	3.0	0.0
G.	Includes instructional aids (e.g. transparencies, slides, CD ROM, web pages, etc)	1.3	0.3	1.0	0.0	0.0	0.0
Section V Mean and STDEV		1.7	0.2	1.6	0.3	0.9	0.0

Appendix E. Individual assessment for each aquaculture curriculum evaluated.

Author		Swann , LaDonn, Jane Brown, Sharon Katz, Russ Merzdorf		The National Council for Agricultural Education		Walker, Susan S.	
		Average	STDEV	Average	STDEV	Average	STDEV
I. Content: Coverage and Quality							
A.	Reflects the Content Standards of the National Science Education Standards or equivalent state documents	0.0	0.0	0.0	0.0	0.0	0.0
B.	Presents scope and sequence in a logical manner	2.0	0.0	2.3	0.3	2.5	0.5
C.	Contains a volume of content that is not excessive for its stated purpose	2.0	0.0	2.0	0.5	2.0	0.0
D.	Achieves a balance between depth and breadth of coverage	2.0	0.0	1.7	0.3	2.3	0.6
E.	Is scientifically accurate	2.5	0.5	1.5	0.5	2.0	0.0
F.	Represents science as dynamic, testable and verifiable	1.0	1.0	1.8	0.3	1.8	0.3
G.	Makes interdisciplinary connections	1.7	0.6	2.2	0.3	2.7	0.3
H.	Applies science and technology to everyday, real-world issues and decisions	1.7	0.6	2.7	0.3	2.7	0.3
I.	Connects topics to relevant social issues and career opportunities	2.0	0.5	2.3	0.6	2.8	0.3
J.	Is unbiased in terms of culture, gender, or race	0.7	0.6	2.0	0.0	2.0	0.0
K.	Is scientifically current	2.8	0.3	1.3	0.3	1.7	0.3
Section I Mean and STDEV		1.7	0.2	1.8	0.2	2.0	0.1
II. Content: Organization and Structure							
A.	Emphasizes active student learning	0.0	0.0	2.0	0.0	3.0	0.0
B.	Uses concrete examples to introduce abstract concepts	2.2	0.3	1.8	0.3	2.8	0.3
C.	Builds upon student's prior knowledge	2.2	0.3	2.0	0.0	2.3	0.6
D.	Emphasizes conceptual understanding rather than rote learning	2.5	0.5	2.2	0.3	2.2	0.3
E.	Provides experiences that build reasoning and analytical skills	1.7	0.8	2.0	0.0	2.8	0.3
F.	Contains open-ended problem-solving investigations	2.3	0.6	1.5	0.5	2.3	0.3
G.	Includes opportunities to use a variety of science process skills	1.7	0.8	1.7	0.3	2.3	0.3
H.	Requires using a wide assortment of analytical instruments and tools	2.3	0.6	1.7	0.6	2.8	0.3
I.	Includes a variety of individual, group, and class activities	0.8	0.8	2.2	0.3	3.0	0.0
J.	Encourages dialogue, collaboration and reflection	1.7	0.8	2.3	0.3	3.0	0.0
K.	Incorporates linkages between science and non science disciplines	2.3	0.6	2.3	0.3	2.8	0.3
Section II Mean and STDEV		1.8	0.9	2.0	0.2	2.7	0.1
III. Content: Format and Readability							
A.	Reading level is appropriate for intended student population	2.3	0.6	1.5	0.5	2.5	0.5
B.	Interesting, flowing narrative that can stimulate and maintain student interest	2.2	0.3	0.7	0.6	2.2	0.3
C.	Print size and typeface ensure legibility	2.3	0.6	2.3	0.3	2.3	0.3
D.	Material is well organized	2.3	0.6	2.3	0.3	2.8	0.3
E.	Identifies the learning objectives for each section	1.7	0.6	3.0	0.0	3.0	0.0
F.	Contains clear and concise headings that direct learner to the major concepts	2.3	0.6	2.7	0.6	2.8	0.3
G.	Uses accurate high quality illustrations that enhance student understanding	2.7	0.6	1.3	0.3	2.7	0.3
H.	Identifies safety precautions	0.7	0.6	1.3	0.6	0.8	0.8
I.	Provides clear instructions for using tools, equipment, and materials	0.8	0.8	0.7	0.6	1.3	0.3
J.	Includes learning and study tips	0.8	0.8	1.5	0.5	1.7	0.6
K.	Gives ideas for supplemental learning opportunities and lists resources	3.0	0.0	2.0	0.5	2.7	0.3
L.	Reflects the diversity of society through activities, language, and illustrations	0.3	0.6	0.7	0.6	0.7	0.6
Section III Mean and STDEV		1.8	0.2	1.7	0.3	2.1	0.1
IV. Assessment							
A.	Connects evaluation instrument to learning objectives	1.7	0.6	2.8	0.3	3.0	0.0
B.	Emphasizes problem solving and real-world applications	2.3	0.6	2.5	0.5	2.8	0.3
C.	Embeds assessment throughout the instructional program	1.5	0.5	2.3	0.3	3.0	0.0
D.	Includes a variety of assessment strategies	1.2	0.3	2.0	0.5	2.7	0.3
E.	Assesses development of processing skills	0.3	0.6	1.5	0.5	2.7	0.3
Section IV Mean and STDEV		1.4	0.0	2.2	0.4	2.8	0.1
V. Teacher Resources							
A.	Provides background information about content	1.2	0.3	2.2	0.3	1.3	0.3
B.	Suggests lesson sequences and instructional strategies	0.3	0.6	3.0	0.0	2.7	0.6
C.	Offers ideas for adapting materials to different audiences	0.3	0.6	1.8	0.8	1.2	0.3
D.	Includes suggestions for using appropriate instructional technology	1.7	0.6	2.2	0.3	1.8	0.3
E.	Identifies health and safety concerns	0.8	0.8	1.2	0.8	1.0	0.5
F.	Contains a master material and equipment list	0.3	0.6	2.3	0.6	3.0	0.0
G.	Includes instructional aids (e.g. transparencies, slides, CD ROM, web pages, etc)	3.0	0.0	3.0	0.0	1.8	0.3
Section V Mean and STDEV		1.1	0.2	2.2	0.2	1.8	0.1

Appendix E. Individual assessment for each aquaculture curriculum evaluated.

Author		White, S. ME/NH Sea Grant	
I. Content: Coverage and Quality		Average	STDEV
A.	Reflects the Content Standards of the National Science Education Standards or equivalent state documents	2.7	0.6
B.	Presents scope and sequence in a logical manner	2.0	0.0
C.	Contains a volume of content that is not excessive for its stated purpose	2.0	0.0
D.	Achieves a balance between depth and breadth of coverage	2.3	0.6
E.	Is scientifically accurate	2.5	0.5
F.	Represents science as dynamic, testable and verifiable	2.0	0.0
G.	Makes interdisciplinary connections	2.0	1.0
H.	Applies science and technology to everyday, real-world issues and decisions	2.3	0.6
I.	Connects topics to relevant social issues and career opportunities	2.3	0.6
J.	Is unbiased in terms of culture, gender, or race	2.5	0.7
K.	Is scientifically current	1.7	0.6
Section I Mean and STDEV		2.2	0.1
II. Content: Organization and Structure			
A.	Emphasizes active student learning	2.7	0.6
B.	Uses concrete examples to introduce abstract concepts	3.0	0.0
C.	Builds upon student's prior knowledge	1.7	0.6
D.	Emphasizes conceptual understanding rather than rote learning	2.5	0.5
E.	Provides experiences that build reasoning and analytical skills	2.7	0.6
F.	Contains open-ended problem-solving investigations	2.7	0.6
G.	Includes opportunities to use a variety of science process skills	2.7	0.6
H.	Requires using a wide assortment of analytical instruments and tools	2.3	0.6
I.	Includes a variety of individual, group, and class activities	2.7	0.6
J.	Encourages dialogue, collaboration and reflection	2.7	0.6
K.	Incorporates linkages between science and non science disciplines	1.7	0.6
Section II Mean and STDEV		2.5	0.6
III. Content: Format and Readability			
A.	Reading level is appropriate for intended student population	2.3	0.6
B.	Interesting, flowing narrative that can stimulate and maintain student interest	2.2	0.3
C.	Print size and typeface ensure legibility	2.0	0.0
D.	Material is well organized	2.7	0.6
E.	Identifies the learning objectives for each section	3.0	0.0
F.	Contains clear and concise headings that direct learner to the major concepts	3.0	0.0
G.	Uses accurate high quality illustrations that enhance student understanding	1.8	0.3
H.	Identifies safety precautions	1.0	0.0
I.	Provides clear instructions for using tools, equipment, and materials	1.2	0.3
J.	Includes learning and study tips	1.7	0.6
K.	Gives ideas for supplemental learning opportunities and lists resources	2.2	0.8
L.	Reflects the diversity of society through activities, language, and illustrations	1.0	1.4
Section III Mean and STDEV		2.0	0.1
IV. Assessment			
A.	Connects evaluation instrument to learning objectives	1.3	0.3
B.	Emphasizes problem solving and real-world applications	2.3	0.6
C.	Embeds assessment throughout the instructional program	1.5	0.5
D.	Includes a variety of assessment strategies	1.3	0.6
E.	Assesses development of processing skills	1.3	0.6
Section IV Mean and STDEV		1.6	0.5
V. Teacher Resources			
A.	Provides background information about content	2.3	1.2
B.	Suggests lesson sequences and instructional strategies	2.0	0.0
C.	Offers ideas for adapting materials to different audiences	1.5	0.9
D.	Includes suggestions for using appropriate instructional technology	1.5	0.5
E.	Identifies health and safety concerns	1.2	0.3
F.	Contains a master material and equipment list	1.3	0.6
G.	Includes instructional aids (e.g. transparencies, slides, CD ROM, web pages, etc)	1.7	0.6
Section V Mean and STDEV		1.6	0.1

