Designing Training Materials for Student-Teacher-Scientist Partnerships:

A Guide for Scientists

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TABLE OF CONTENTS

Introduction ......................................................... 3

Training Material Design Criteria for STSP Programs
Guidelines for Components to Include ........... 4
Guidelines for Layout & Organization of
the Materials ......................................................... 6
Guidelines for Writing the Concept & Skill
Building Lessons & Instructions .................... 7
Important Issues to Consider ......................... 8

Key Science Education Methods
Relevant to STSP Programs ......................... 10

Resources ........................................................... 11

RESOURCES

Science Education


National Science Teachers Association (NSTA).
Address: 1840 Wilson Blvd., Arlington VA 22201
Phone: 703.243.7100 Fax: 703.243.7177
Online: http://www.nsta.org/

Education Standards

Online: http://books.nap.edu/html/nses/html

Online: http://www.project2061.org/

*Geography for Life: National Geography Standards.* National Council for Geographic Education.
To order: 16A Leonard Hall, Indiana University of Pennsylvania Indiana PA 15705-1087
Online: http://www.ncge.org/tutorial/standards/index.html

*National Council of Teachers of Mathematics- Standards 2000.*
Phone: 1.888.220.1952
Online: http://www.nctm.org/standards2000/index.html

*National Educational Technology Standards (NETS).* International Society for Technology in Education.
Online: http://cnets.iste.org
**Introduction**

Student-Teacher-Scientist Partnership (STSP) Programs are cooperative relationships where students, with the support of their teachers, participate in and contribute to research projects with scientists. Extensive training is needed for students to collect and report accurate data to scientists. Consequently, a special preparatory curricula is needed to make students’ partnerships with scientists effective and motivating.

This booklet was created to guide scientists participating in STSPs (or interested in participating) in development of training materials. Such training materials include preparatory lessons which build the concepts and skills necessary and data collection procedures. They are commonly organized into “teacher’s guides.”

This information is intended especially for the elementary and middle school levels, but is applicable to all levels, K-12.

The main set of recommendations included in this guide are the *Training Material Design Criteria for STSP Programs*, including guidelines and important issues to consider. Along with these criteria are a few *Key Science Education Methods Relevant to STSP Programs* and *Resources* to consult on science education and education standards.

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**Key Science Education Methods Relevant to STSP Programs**

*Authentic Science Learning*

Authentic science learning involves students in science learning by engaging them in actual science research currently being conducted.

*Cooperative Learning*

Cooperative learning involves students in group projects and learning activities, whereby they can develop the skills needed to work in cooperation with others.

*Hands-On Learning*

Hands-on learning engages students in learning through first hand experience, rather than by text book lectures or rote memorization of facts. In science education, this refers to involving students in the science process skills of observing, measuring, recording, classifying, interpreting data, inferring, predicting, investigating, and making models.

*Inquiry Based Approach to Science Learning*

The inquiry based approach to science learning engages students in the full process of science, whereby students choose and conduct science research projects guided by their own inquiry. With this approach, hands-on learning is strengthened, as students initiate research questions, collect data, interpret data, and present the results. This approach is intended to reflect the process of science as it is practiced.
TRAINING MATERIAL DESIGN CRITERIA FOR STSP PROGRAMS

GUIDELINES FOR COMPONENTS TO INCLUDE

A. Engage students in the full process of science from identifying questions to data analysis.

It is important for both motivation and educational value that students gain a deep understanding of the research project and learn from participation in question identification, data collection, data analysis, and presentation of results.

B. Provide science background information; written at introductory level and placed separate from data collection instructions.

Introductory background information (college 101 level) is important since participating teachers may not have strong science background experience. Paragraphs of background information should not disrupt the flow of data collection instructions, but may be placed immediately preceding or following instructions for quick reference.

C. Provide curriculum / education standards integration assistance.

Appropriate references to science, math, and geography standards in education can be illustrated in a matrix that matches the concepts/skills to education standards. Such standards include the National Science Education Standards (see page 11 for a list). This allows teachers to readily integrate the STSP program with local curriculum and justify participation in the program.

D. Provide categorized resource lists.

Resources commonly used in the classroom include educational videos, Websites, science reference books, children’s picture books, educational posters, and local resources/organizations. Recommending useful resources (including source information) should reduce teacher preparation and research time.

T. Consider school limited funding constraints.

School budgets for additional science equipment, field trips, and teacher leave days (providing substitute teachers during STSP program training/workshops) are often limited. Ways to provide funding for these expenses are extremely beneficial for successful program implementation.

* Criteria of stronger importance at the elementary level.
** Criteria of stronger importance at the elementary and middle school levels.
E. Provide classroom management suggestions on how to engage the whole class in data collection and how to manage the class during fieldwork.*

During fieldwork teachers have experienced difficulty with classroom management. Engaging the whole class, even when only a few measurements need to be collected is important for both the educational experience of all students and for minimizing behavior problems during field work. Teachers experienced with conducting field research with students can assist with this recommendation.

F. Provide age appropriate materials.**

It is important that the concepts and skills required for the science investigation, along with the resulting lessons and procedures are age-appropriate for the target level(s) of participating students. Age-appropriateness encompasses physical ability (performing skills) and cognitive development level (understanding concepts).

G. Provide student assessment sections/ideas.

Assessing student participation, knowledge, and skills is an integral task of the classroom teacher. Model practical assessment exercises with scoring guides (called rubrics) assist teachers with this task, especially those who are not experienced in teaching hands-on science.

H. Include student pages with age-appropriate reading level and formatting.**

Examples include student pages explaining science background information, work sheets for practicing necessary skills, and data collection forms. All student pages should be written at an age-appropriate reading level and include “student-friendly” formatting such as larger font size, instructional and fun graphics, and large spacing where student writing is necessary.

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** IMPORTANT ISSUES TO CONSIDER

Q. Recognize the importance of a strong collaborative relationship with teachers and provide follow-up support including information sharing and training workshops.

The relationship between STSP program scientists and teachers is critical to the success of the program. There should be an equal, collaborative status of each partner and two-way exchange of information. STSP program scientists also need to provide regular and consistent research communication and ongoing support, e.g., site visits (to schools), yearly meetings, and refresher training.

R. Recognize the importance of the involvement and support of the entire learning community, especially school administration and other teachers, but also including the students’ parents and community members.

School administration support is critical for successful STSP program implementation, therefore measures taken to encourage administration support are valuable. In addition, networking of participating teachers, especially at the local level, is important for teacher to teacher support and idea exchange. Involvement and support of other learning community members, including students’ parents, local businesses, and relevant organizations, is beneficial to providing resources such as local science knowledge, adult volunteers for field work, and donation of funds/equipment.

S. Consider time constraints and issues.

Time constraints teachers face include lack of preparation time needed for STSP program implementation, fixed school day schedules, and arranging time to fit STSP program activities into required curriculum. Some ways to address these issues include reduce teacher prep time needed, develop lessons and procedures that fit with class schedules, and minimize within lesson transitions that consume valuable time. Strong communication with participating teachers is critical to address these issues since they may vary from school to school and teacher to teacher.
GUIDELINES FOR LAYOUT AND ORGANIZATION OF THE MATERIALS

I. Clearly organize materials with easy to follow, graphical layout.

For ease of use it is important that all lessons and instructions are clearly organized with page referenced outlines. Training materials should include instructional graphics to assist with the explanation of scientific concepts and procedures.

J. Provide consistent lesson format.*

Each lesson and set of instructions should be formatted with consistent sections and components such as: Title, Grade Level, Objective/Purpose, Time Requirements, Concepts/Skills/Processes, Materials Needed, Prerequisites, Procedure (instructions), Follow-Up Discussion, Student Assessment.

K. Write instructions in step-by-step format.*

It is important to clearly communicate measurement procedures by concisely writing them in a step-by-step format to be followed (like reading a recipe). Large paragraphs of science background information and justification should be avoided in procedure instructions. This information can be referenced and placed immediately following the instructions.

L. Start lessons with very basic concepts/skills and build upon them sequentially.

Following the developmental sequence, break down necessary concepts and skills and build upon the basics with lessons that teach more complex concepts and skills. One way to identify the basic concepts and skills is by performing the complete measurement procedure(s), as if presenting it to the general public, and documenting in detail every scientific explanation and task required (write down or tape record). Considering ability level, group these science explanations and tasks into basic concepts and skills.

GUIDELINES FOR WRITING THE CONCEPT AND SKILL BUILDING LESSONS AND THE INSTRUCTIONS

M. Develop hands-on lessons where possible.**

Hands-on learning has received increasing recognition as valuable to the educational experience and is recommended by the National Science Education Standards. STSP measurement procedures are generally hands-on in nature and corresponding lessons developing necessary skills and concepts should also be based on hands-on learning, where possible.

N. Include specific information to make science lessons relevant to students.

To fully and deeply engage students in the STSP research project, including the data collection procedures, it is important to set the lessons into a real world context.

O. Include “outdoors” lessons where relevant.**

In general, students enjoy activities that involve outdoor exploration and discovery. Preparatory lessons should engage students in such outside investigations, where relevant.

P. Develop inquiry-based lessons where possible.**

The inquiry-based approach to learning is an integral part of the National Science Education Content Standards and is becoming increasingly important in K-12 science education. This approach involves students in developing research topics and following the scientific process by collecting and analyzing necessary data and communicating the results. Although students can not change the focus of a STSP program investigation, they can be engaged in similar projects during preparatory lessons and by conducting further investigations using the data collected for the STSP program.