

## ASPB Education Foundation Proposal

### DNA for DINNER? GENES, GENOMES, GENETICS

#### Building a 4-H Science, Engineering and Technology Education Curriculum



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David Gilchrist, Director, Partnership for Plant Genomic Education, University of California, Davis

## Abstract

This proposal expands on educational resources, developed with funding from the ASPB Education



Foundation, by creating complementary curricula and related materials. With earlier funding, we created two educational displays, Foods:

Past, Present and Future (left) and Genes, Genomics



and Diversity (right). They have been widely used at county and state fairs,

meetings of professional organizations, Master Gardeners' gatherings, teacher

conferences and were modified for Rice Coordinated Agriculture Program (RiceCAP) and Barley CAP outreach

efforts. We also made companion educational baseball-type cards (right) that

capture key information from the displays. With funds awarded in 2007, we created



a GENE-ie Juice Bar (left), which teaches that DNA and

genes are a natural part of our lives. These resources have been very popular at a variety of

venues, catching peoples' attention because of their colorful and tactile messages. Recently

increasing numbers of teachers and educators have borrowed them for classroom use. While they are useful for

these situations, developing activities to accompany the displays would maximize their educational impact. In

addition to an existing network of users, a new outlet for our educational resources became available through a 4-

H Science Education and Technology (SET) program. This effort currently reaches nearly 6 million youth in

urban, suburban and rural communities. A new SET initiative plans to involve another 1 million young people

over the next five years, 100,000 in California, and Lemaux is on the curriculum development committee for that

project. In the present proposal, we will update and expand a curriculum developed for 4-H in 1994 by Lemaux

and others, "Biotechnology and Foods". This will be accomplished using the rubric developed for 4-H SET. We

will modify existing activities and create a new one on genomics to be a stand-alone 4-H SET curriculum, using

the rubric developed for 4-H SET and this will insure wide-scale dissemination through the national 4-H SET

curriculum repository. Activities developed for the curriculum will also be made complementary to the displays

and juice bar and they can accompany these resources for use by the existing and expanding network of teachers.

## Introduction

America's youth do not have the necessary science and technology skills to compete in today's technology-driven workforce (CSEPP 2006). Based on a study by the National Assessment of Educational Programs, only 18 percent of high school seniors are proficient in science (NAEP 2000) and only 5 percent of college undergraduates earn degrees in science and engineering (CSEPP 2006). Thus, in the next decade, our nation may face a significant workforce shortage in critical science and technology fields – unless we generate more student interest and motivation to pursue careers in these areas.

Although historically 4-H has been associated with farm-related tasks, like animal husbandry and domestic skills, more recently 4-H has expanded its focus and now has programs that provide youth with out-of-classroom, hands-on learning experiences that include exploration, discovery and science. These programs involve disciplines as broad as environmental science, robotics, rocketry, GIS/GPS systems, and animal science. These opportunities are offered through after-school 4-H programs, summer camps, and community clubs.

4-H is a mandated function of Cooperative Extension and a part of the nation's 106 land-grant universities and colleges; it is the only youth development program with a direct connection to technological advances coming out of state land-grant universities. In an effort to channel more of America's youth toward science and technology, the 4-H SET program was initiated in 2005 (<http://www.fourhcouncil.edu/scienceengineeringtechnology.aspx>). At present this program reaches nearly 6 million youth in urban, suburban and rural communities. A recently initiated SET initiative will engage another 1 million new young people in SET projects over the next five years. California is taking a lead in this effort by recruiting 100,000 of the youth (<http://groups.ucanr.org/Cal4HSET/>).

Key to the project's success is the idea that science education is more engaging and meaningful when learning focuses on issues of contemporary importance (Zeidler et al., 2005) and takes advantage of current information and educational technologies (Barbab and Dede, 2007). In fact, many students lose interest when science is taught out of context and seems irrelevant to their lives (Brodie 2006). Clearly genetics, genomics and biotechnology is not irrelevant to the lives of today's students. For students to understand the relevance of science and technology in their daily lives, they need to be exposed to information related to these disciplines. While formal classroom opportunities are necessary, Carlson and Maxa (1997) and Kisiel (2006) also advocated for non-formal education programs being important resources to address the science literacy problem.

A primary component of the national 4-H SET program is the creation and national dissemination of innovative SET curricula that support development of scientific literacy in the context of non-formal experientially-based instruction. As a part of this proposal, we will adapt the 1994 Biotechnology Curriculum into a 4-H SET-ready experience appropriate for dissemination, in California and also nationally, to the diverse student audiences in 4-H out-of-classroom afterschool and summer venues.

#### **4-H Biotechnology and Foods Curriculum**

In 1994 when applications of biotechnology in agriculture were nearing commercialization (large scale commercial acreage started in 1995), two UC nutrition education and youth development Cooperative Extension Specialists received a USDA Food Safety Grant to start the What's In Food (WHIF) Food Safety Education Program. The two Specialists and three other individuals, including Lemaux, developed a "Biotechnology and Foods" curriculum for 4-H. The WHIF program was aimed at helping adolescents and their parents develop a better understanding of food safety by addressing food additives, pesticides in food, and biotechnology and food.

In the biotechnology curriculum ([http://ucbiotech.org/edu/edu\\_aids/whifbiotech.pdf](http://ucbiotech.org/edu/edu_aids/whifbiotech.pdf)), a variety of topics were addressed, including genetic diversity, genetic codes and genomes, DNA and chromosomes, building blocks of an organism, genetic engineering and risks and benefits. Each exercise included several hands-on activities, a word wrap, background, suggestions for volunteer leaders, discussion suggestions, questions to ask 4-Hers and leads to finding more information. At the time of its release, a number of workshops were held for county Cooperative Extension advisors in a "train the trainer" effort to get the curriculum to 4-H groups. Although these topics are still of interest, the curriculum has become outdated in the 14 years since its introduction. With the initiation of the 4-H SET initiative, it is time to update this curriculum in order to introduce the concepts of plant genetics and genomics to the present generation of 4-H youth.

In addition to that audience, we also plan to use the activities developed in the curriculum to accompany our two educational displays, Foods: Past and Present and Genes, Genomics and Diversity, and the GENE-ie Juice Bar. These educational resources provide information to audiences about the role of plants and their products in providing the food we eat and about the necessity to continue studying and manipulating plants to assure a safe, affordable and environmentally friendly food supply. Increasingly the venues for the displays, the informational cards and the juice bar are in classrooms, but these resources lack companion activities that teachers can use to

introduce the concepts presented in the displays to their classrooms. The “Biotechnology and Foods” curriculum activities will be updated and modified to fit the lessons encompassed in both the displays and the juice bar.

### **DNA for Dinner Curriculum**

The 4-H SET program and its curriculum development efforts offer the opportunity to increase dramatically the impact of the revised “Biotechnology and Food” curriculum, newly termed the “DNA for Dinner” curriculum. We will adapt this educational resource for use by diverse student audiences for afterschool and summer camp enrichment programs in California and across the country. By coupling this project with the 4-H SET Initiative, it adds to its sustainability. The 4-H program, which has been in existence for over 100 years, is administered through the national Cooperative Extension System, an educational network representing a partnership between federal, state, and local governments, and land-grant universities (Kellogg Commission on the Future of State and Land Grant Institutions, 1999). As such it will magnify the impact of this ASPB Education Foundation effort.

The California SET program has a curriculum committee that has developed a rubric to guide the development of curricula for the program and it insures that they meet the state and national science standards. Lemaux and Smith are a part of that committee and helped to develop the rubric. The DNA for Dinner SET curriculum will be pilot-tested with county-based 4-H audiences to measure content using pre- and post-assessment tools. After the curriculum is finalized, we will conduct a student outcome assessment to measure impact. For parent volunteers to be comfortable with the topic areas, volunteer training sessions must be conducted and these will be made available through professional development opportunities offered by the SET initiative. This training will serve to increase the content knowledge and confidence of 4-H volunteers who will be responsible for bringing the SET projects and activities to 4-H youth.

### **Making DNA for Dinner Curriculum Suitable as Educational Materials for Displays**

Our efforts to develop the educational displays and activities and generate interest in using them (unused educational tools do nothing) have paid off. We have continued to upgrade the displays, build the juice bar and ship them to a large number of venues. In 2005-2006 and in 2007-2008, we received funds from the ASPB Education Foundation for shipping the displays and the juice bar. Based on those funds and a small amount of Cooperative Extension money, we were able to provide these educational tools to a large number of organizations (nearly 100) that have served large audiences (in the 1000’s) from 2005-2008.

In addition to the 4-H SET avenue for dissemination, the Berkeley group has formed a relationship with David Gilchrist and Barbara Soots at the Partnership for Plant Genomics Education at the University of California Davis. This program, in existence for the past 15 years, has a network of teachers and students in the greater Sacramento Valley, a very culturally diverse region (Stodghill and Bower, 2002). Their successful teacher training sessions have reached 1900 teachers on both a national and regional scale; they will utilize our educational resources in future workshops. PPGE currently has a network of teacher collaborators that make up an excellent pool to provide teacher input on development of our educational curriculum. They can provide feedback and test the modules before they are disseminated through 4-H SET and with the displays. In addition to being placed on the California and national SET website for dissemination to 4-H groups and being made available on CD ROMs to teachers and volunteers, we will also make the curriculum available through the UC Biotechnology Workgroup website, <http://ucbiotech.org> (Resources section), where the displays and juice bar are currently available for loan and through the PPGE website, <http://ppge.ucdavis.edu>.

### **Why Should the Foundation Continue To Support Our Educational Efforts?**

The displays have been valuable educational resources – widely used and appreciated. They are an educational resource that eliminates the need for individuals to develop such resources on their own. The success of the materials is measured in part by the number of groups and individuals who have made requests for their use, often repeated and sometimes permanent. Both displays and the juice bar have been in high demand for large and small venues – county and state fairs, gardening meetings, farm days, career fairs, teacher workshops, professional meetings and other educational events. With the development of activities to accompany the displays, their usefulness for the increasing number of teachers requesting them will expand. Also the opportunity to couple our efforts with that of the 4-H SET and the PPGE program will amplify the impact of the educational resources in which the ASPB Education Foundation has invested.

It is important to find ways to sustain these educational resources since they already have interested clientele and that clientele expands yearly as more people become familiar with them. Although the 4-H SET initiative will receive a small amount of funding to initiate their efforts, the bulk of the funding to create and implement the curricula will come from efforts, such as the ones described in this proposal. I hope the Education Foundation can see the importance of supporting this effort for tomorrow's youth.



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## Budget Justification

**Personnel.** Funds are requested for 30% of the time and benefits for the Communication Specialist/Graphic Designer, Barbara Alonso, who created the designs and constructed the current displays and juice bar. She has experience with such outreach efforts; she has also created the educational outreach materials for the CSREES Rice Coordinated Agriculture Project (RiceCAP) and BarleyCAP. She will be responsible for designing and implementing the DNA for Dinner curriculum and will create the materials to accompany the display. She is also responsible for repacking, repairing and reshipping the displays and the GENE-ie Juice Bar. To provide outreach experience, we will also involve an undergraduate student in the summer to help develop and test the curriculum.

**Shipping Costs.** Based on experience of the past few years, we estimate predicted needs to cover shipping costs for the two existing displays (20 university-rate shipments for displays; 5 shipments for Juice bar).

**Replacement Needs.** With long distance shipping and wear and tear of use, we request funds to replace existing modules and replace the custom shipping boxes.

**CD ROMs and Printed materials.** Based on feedback from Cooperative Extension and 4-H SET personnel, the most effective means to provide the curriculum and related materials is via CD ROM. Therefore we budgeted for 500 copies of the curriculum on CD ROM and for mailers and shipping costs. Although all materials developed will be available online, there will be some occasions, *e.g.*, when displays are used in public venues and for teachers with limited resources, where we will need to provide copies of the curriculum. We will also make bookmarks to advertise the displays and curriculum, which will be disseminated to generate interest.

**Travel.** Three people who will provide guidance to the project, Barbara Soots, Martin Smith and David Gilchrist, are located on the Davis campus. Lemaux will interact with them primarily by email and phone conversations but requests money to visit the Davis campus to discuss the curriculum and its design and also to travel to county meetings for curriculum assessment.

**Budget**

30% time for Communication Specialist/Graphic Designer .....	\$15,600
Benefits for Communication Specialist/Graphic Designer .....	\$3,427
Shipping costs for two displays and juice bar	
\$30/round trip, 20 shipments total (University rate).....	\$600
Replacement shipping containers and materials for displays/juice bar.....	\$300
CD ROMs .....	\$1,000
Mailers and shipping costs.....	\$245
Printing costs for bookmarks to advertise curriculum and displays.....	\$200
Travel .....	\$200
Undergraduate stipend+benefits, \$11.25 hourly rate, 4 hours per week for 12 months .....	\$540
<b>Total .....</b>	<b>\$22,112</b>