

**FREP 2010 Grant
Agreement # 10-0010-SA
Final Report**



A. Project Information:

Final Report

Time Period: January 2011 – May 2013

Project Titles:

- *Chemistry, Fertilizer, and the Environment* – New comprehensive unit for 7-12 Grade Students.
- *What Do Plants Need to Grow?* – Update existing unit for 2-4 Grade Students.

FREP Grant # 10-0010-SA

Project Leaders:

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B. Objectives:

- Create a new comprehensive, multi-lesson unit that will educate students in grades 8-12 about the relationships between fertilizers, food, plant nutrition and the environment.
- Update and align the already existing unit *What Do Plants Need to Grow?* for grades 2-4.

- Develop five “Grab ‘n’ Go” teacher training kits that will be used to introduce teachers to the new curriculum and encourage them to implement the curriculum into their classrooms.
- Increase student understanding of the essential role of plant nutrients in agriculture production.
- Enhance student appreciation of the agriculture industry’s efforts to improve environmental stewardship.
- Encourage students to pursue a career in plant sciences.

C. Abstract:

Challenges within the industry are numerous and California farmers continually investigate the solution to meeting the needs of a growing population with shrinking resources. With the development of new technology, today’s farmers and ranchers are producing food, clothing, forest and floral products on less land for more people. Fertilizer plays a crucial role in improving agriculture efficiency yet the general public has little knowledge of this topic.

To address this problem, the California Foundation for Agriculture in the Classroom (CFAITC) created agricultural education materials about the relationships between plant nutrient requirements, fertilizers, and the environment. These education materials are to be used by teachers in elementary through high school classrooms. *Chemistry, Fertilizer, and the Environment* is a five lesson unit for 8th through 12th grade students and *What Do Plants Need to Grow?* is a 2nd – 4th grade unit comprised of twelve lessons. These educational resources are aligned to the most current Content Standards for California Public Schools including the Common Core and Next Generation Science Standards. Grab ‘n’ Go kits have been assembled and may be borrowed by teachers who lack the basic science equipment used in the lab activities. Hands-on activities are designed around topics to help students connect plant nutrients to their daily lives.

The development of the two education units began with curriculum development meetings. Classroom teachers and CFAITC staff attended this meeting and a representative from the California Fertilizer Foundation gave a presentation on fertilizer and plant nutrients. Lessons were developed and submitted for technical review by industry experts and were also piloted by classroom teachers. Lessons were revised based upon expert feedback. Both units were completed at the end of May, 2013 and are being promoted and distributed to elementary through high school teachers.

Teachers have responded positively to the release of the new plant nutrient education units. From June 2013 to August 2013, *Chemistry, Fertilizer, and the Environment* was downloaded 1,950 times and *What Do Plants Need to Grow?* was downloaded 847 times. 650 printed copies of *Chemistry, Fertilizer, and the Environment* were distributed to all high school Agriculture Science teachers attending the annual California Agriculture Teachers Association conference at Cal Poly in June, 2013. An additional 94 printed copies have been mailed to teachers who placed an order from our office. A

total of 212 printed copies of *What Do Plants Need to Grow?* have been distributed to teachers at education events or through email and phone orders.

1,059 = Total copies of *What Do Plants Need to Grow?* downloaded from CFAITC website or distributed through mail or educational events from June 2013 to August 2013.

2,694 = Total copies of *Chemistry, Fertilizer, and the Environment* downloaded from CFAITC website or distributed through mail or educational events from June 2013 to August 2013.

CFAITC plans to promote and distribute the two plant nutrient education units on a continual basis. At the end of each year, CFAITC conducts an annual survey of teachers who are using CFAITC's curriculum. Data is compiled into a report with information on where and how the curriculum is used and how it is impacting students. At the time of this report, the two units developed for the FREP project had only been in distribution for the three summer months when school was out of session. Additional data will be collected and will be available at the end of year.

D. Introduction:

The objective of this project was to create and implement educational lessons for elementary through high school students that result in a better understanding of the purpose of fertilizer in food production and new technologies to manage fertilizer use. The project was developed to address public lack of knowledge and in some cases misinformation regarding plant nutrient requirements and how those requirements are met in order to feed a growing population with limited resources.

Two comprehensive units of lessons were developed. Each unit is aligned to the most current Content Standards for California including the Common Core and Next Generation Science Standards. Units include background information for teachers and detailed instructions to carry out hands-on activities in the classroom. "Grab 'n' Go" kits are available for teachers to borrow if they lack basic equipment necessary to perform the lesson plans. CFAITC has and will continue to hold teacher workshops at various conferences to train teachers in the use of the lessons with their students.

The products of this project are:

- 1) *Chemistry, Fertilizer, and the Environment*: A five lesson unit for 8th through 12th grade students.
- 2) *What Do Plants Need to Grow?*: A twelve lessons unit for 2nd – 4th grade students.

E. Work Description:

Project Task	Completion Date	Product, Results, Measurable Outcomes
1. Receive funds for project	January 2011	N/A
2. Plan <i>Chemistry, Fertilizer and the Environment</i> 3-day development meeting	April 2011	N/A
3. Facilitate <i>Chemistry, Fertilizer and the Environment</i> 3-day development meeting	July 2011	Participants included: <ul style="list-style-type: none"> • Eric Dyer, Ag/Chem teacher, Woodland High School • Holly Whitworth, AP Environmental science teacher, Pioneer High School • Kyle Brossard, middle school Science teacher, Park Middle School • Corrie Pelc, director of programs, CA Fertilizer Foundation • Jenna Swenson, Curriculum Coordinator, California Foundation for Agriculture in the Classroom • Judy Culbertson, Executive Director, California Foundation for Agriculture in the Classroom • Group created outlines for an instructional unit with five lessons
4. Organize <i>Chemistry, Fertilizer and the Environment</i> lesson drafts and develop background information	September-November 2011	Draft instructional unit lessons

Project Task	Completion Date	Product, Results, Measurable Outcomes
5. Plan <i>What Do Plants Need to Grow?</i> 1-day update meeting.	February 2012	N/A
6. Facilitate <i>What Do Plants Need to Grow?</i> 1-day update meeting.	February 2012	Brainstorm ideas for updating this 12 lesson unit.
7. Present DRAFT <i>Chemistry, Fertilizer and the Environment</i> unit overview and 2 lessons at National Agriculture in the Classroom Conference.	June 2012	30 teachers receive training to implement instructional unit in the classroom.
8. Present DRAFT <i>Chemistry, Fertilizer and the Environment</i> unit overview and 2 lessons at California Science Teachers Association Conference.	October 2012	30 teachers receive training to implement instructional unit in the classroom.
9. Present DRAFT <i>Chemistry, Fertilizer and the Environment</i> unit overview and 2 lessons at annual CA Foundation for Agriculture in the Classroom Conference.	October 2012	25 teachers receive training to implement instructional unit in the classroom.
10. Revise remaining 3 lessons for <i>Chemistry, Fertilizer and the Environment</i> unit	January – March 2013	Fine tune all five lessons and align with content standards to prepare for pilot testing in the classroom.

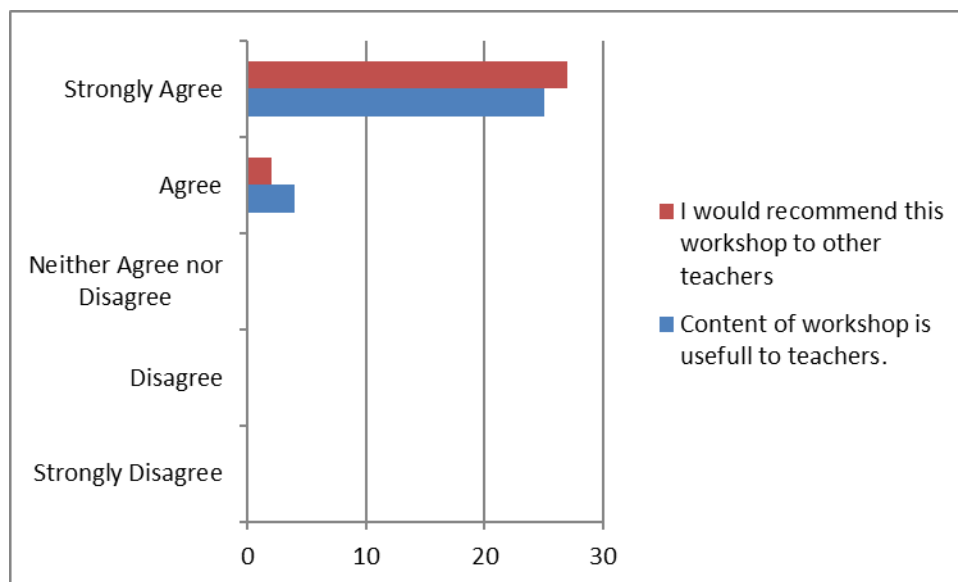
Project Task	Completion Date	Product, Results, Measurable Outcomes
11. Pilot <i>Chemistry, Fertilizer and the Environment</i> two California high school classrooms.	March 2013	Feedback for curriculum improvements from: Ag Chemistry teacher Haley Clement at Liberty Ranch High School, Galt, CA Advanced Placement Chemistry teacher (Richard Prizznick) University Preparatory Academy, San Jose, CA
12. Write updated lessons for <i>What Do Plants Need to Grow?</i>	December 2012 March 2013	Continue writing updated lessons and align to content standards with a matrix
13. Pilot test select lessons from <i>What Do Plants Need to Grow?</i>	March 2013	Incorporate teacher feedback to revise and finalize lessons.
14. Layout and design <i>What Do Plants Need to Grow?</i>	April – May 2013	Design graphics and layout for unit.
15. Expert review of <i>Chemistry, Fertilizer and the Environment</i>	March – May 2013	Submit unit lessons for review by California Fertilizer Foundation Tim Hartz, UC Cooperative Extension, UC Davis Plant Sciences Department Timothy Doane, Department of Land, Air and Water Resources, UC Davis California Farm Bureau Federation
16. Layout and design <i>Chemistry, Fertilizer and the Environment</i>	April – May 2013	Make changes based upon pilot feedback, work with layout and graphic design experts to prepare for printing.

Project Task	Completion Date	Product, Results, Measurable Outcomes
17. Print <i>Chemistry, Fertilizer and the Environment</i> sets.	May, 2013	Hard copies of instructional unit available in both paper and CD format for distribution at ag days, teacher trainings, and conference exhibits.
18. Print and distribute <i>What Do Plants Need to Grow?</i>	May 2013	Printed unit is available for online ordering, downloads and distribution at events.
19. Develop and assemble <i>Chemistry, Fertilizer and the Environment</i> Grab 'n' Go kits.	March 2012 – May 2013	Assemble five ready-to-use teacher training kits that highlight <i>Chemistry, Fertilizer and the Environment</i> lesson activities. Teachers may also borrow these for use in their classrooms.
20. Add <i>Chemistry, Fertilizer and the Environment</i> to lesson plan section of www.cfaitc.org .	June, 2013	Instructional unit accessible worldwide.
21. CFAITC staff training: <i>Chemistry, Fertilizer and the Environment</i> Grab 'n' Go kits.	June 2013	CFAITC staff skilled to train educators how to successfully implement new curriculum.
22. Promote new/updated resources through social media.	June 2013	Increased website downloads of instructional unit.
23. Promote new/updated resources through monthly <i>Cream of the Crop</i> e-newsletter.	June 2013	12,000 people receive announcement of new resource. Increased website downloads of instructional unit.
24. Compile the results of project for final report.	August, 2013	Project complete and final report submitted.
25. Project evaluation.	December 2013	Annual electronic survey administered to teachers at end of each year.
26. Project promotion and dist.	Ongoing	Increase use of lessons in classroom.

F. Data/Results:

Although the *Chemistry, Fertilizer, and the Environment* high school unit was not yet complete, a unit overview and two sample lessons were presented to educators at a workshop hosted by CFAITC at the National Agriculture in the Classroom Conference in June, 2012 in Loveland, CO. and at the California Science Teachers Association Conference in San Jose in October, 2012.

The following information was gathered by surveying workshop participants with Survey Monkey.



Comments from workshop participants at National Agriculture in the Classroom and CA Science Teacher Association Conferences:

- Excellent! Fun and very useful!
- Fantastic ideas and very fun for us as adults too! Thank you!
- Great!
- Mandi was awesome! Great info, great presentation!
- Very fun! Loved the molecular shuffle especially!
- Love the “molecular shuffle” activity!
- Great hands-on activities! I will be using both labs. Can’t wait to see the other online lessons.
- Awesome!
- Excellent activity
- You win the prize of the day! Thank you for actually having us do activities! Great teacher.
- Chemistry is so abstract that having some movement activities mixed with lab work is awesome.
- This is very applicable to my Ag classes, plant science and natural resources.
- I am interested in extensions to upper levels and more online resources.
- This is an excellent way to integrate Ag science into standards.
- Can you say R&D?? ☺ Love the new unit.
- I believe this is going to be a great way to utilize chemistry in my Ag classes.
- I loved the stand up activity for the periodic table with the yellow ribbons?
- It will fit into common core standards and fits perfectly into my solutions unit. Students will be able to utilize the new school garden to do these activities.
- Thank you! It was fun a, and will be helpful for me as an AP environmental science and biology teacher.

CFAITC is continuing to hold workshops to train teachers in the use of the *Chemistry, Fertilizer, and the Environment* unit. The completed unit was released to teachers at the end of May 2013. At the time of this report, school was out of session for several months. We expect teachers to begin using our two new units in their classrooms this fall and will conduct teacher surveys to gather information about the value of the lessons with our annual survey at the end of the year.

G. Discussion and Conclusions:

Grant project objectives were met. One new high school unit, *Chemistry, Fertilizer, and the Environment* was developed for use in 8th – 12th grade classrooms. This unit is comprised of five lessons. These lessons teach students about: solutes and solvents, serial dilution and parts per million, plant nutrient requirements, best management practices for nutrient management, the nitrogen cycle, basic chemistry concepts, soil pH and nutrient availability, and testing soil samples for available nitrogen.

Twelve lessons from the existing unit, *What Do Plants Need to Grow?* were updated for use in 2nd -4th grade classrooms. The lessons in this unit teach students about: basic plant parts and their functions, requirements for healthy plant growth, soil composition, and the role of decomposers. Students will conduct several investigations to observe plant root growth, phototropism, and the effects of different concentrations of fertilizer solutions on classroom plants.

These units are aligned to the most recent Content Standards for California public schools. Lessons are designed to engage students through hands-on activities that allow them to explore the types of activities carried out by farmers and plant scientists to produce our food and fiber while practicing environmental stewardship. After participating in the lessons, students will have a better understanding of what plant nutrients are, why they are important, and how farmers and scientists are continually improving methods to provide crops with the right plant nutrients in the right amounts, at the right time and in the right place.

The lessons from each unit were pilot tested in classrooms, reviewed by experts in the plant nutrient field, and presented to teachers at workshops. Workshop participants gave overall positive reviews of the lessons as seen in the “Results” section of the report. “Grab ‘n’ Go” teacher training kits were used in CFAITC workshops to train teachers how to use the lessons in their classrooms and are available for teachers to borrow if they lack the proper equipment to teach lab activities.

At the time of this report, the units had only been available to teachers over the three months of the summer. Once school has been back in session for several months, CFAITC will gather data on how teachers used the lessons and what students gained

from them. This data will be collected as part of CFAITC's annual survey sent to thousands of teachers in CFAITC's database each December.

H. Project Impacts:

The impacts of this project apply to teachers and students and will also be passed on to parents as students share information learned in class and carry out homework assignments. The educational materials created for this project are designed to increase student understanding of the importance of plant nutrients in growing our food supply and how those nutrients are carefully managed by farmers with the latest technology. Lessons will not only focus on nutrients in food production but will also teach students that they must be responsible for following fertilizer directions at home when fertilizing lawns, vegetable, and flower gardens.

These educational materials are being promoted to teachers on continual basis. Feedback from surveys and discussions with teachers will be used to improve support materials for teachers and students who are using the lessons.

I. Outreach Activities Summary:

- June, 2012: Presented a DRAFT of the *Chemistry, Fertilizer and the Environment* unit to 30 teachers at the National Agriculture in the Classroom Conference in Loveland, Colorado. Teachers received training to implement this instructional unit in their classroom.
- October, 2012: Presented a DRAFT of the *Chemistry, Fertilizer and the Environment* unit to 30 teachers at the California Science Teachers Association Conference in San Jose, California. Teachers received training to implement this instructional unit in their classroom.
- October, 2012: Presented a DRAFT of the *Chemistry, Fertilizer and the Environment* unit to 25 teachers at the California Foundation for Agriculture in the Classroom Conference in Sacramento, California. Teachers received training to implement this instructional unit in their classroom.
- June, 2013: CFAITC inserted 650 copies of the completed *Chemistry, Fertilizer and the Environment* unit into all teacher registration bags at the California Agriculture Teachers Association Conference at Cal Poly. One lesson from the unit was highlighted in a teacher workshop by one of CFAITC's pilot teachers, Haley Clement.

- July, 2013: CFAITC distributed copies of the completed *Chemistry, Fertilizer and the Environment* unit at our booth during our annual California Foundation for Agriculture in the Classroom teacher conference in San Diego, California.
- July, 2013: CFAITC distributed copies of the completed *Chemistry, Fertilizer and the Environment* unit at our booth during the National Agriculture in the Classroom teacher conference in Minneapolis, Minnesota.
- October, 2013: CFAITC is registered to present the completed *Chemistry, Fertilizer and the Environment* unit at the California Science Teachers Association Conference in Palm Springs, California.
<http://2013californiascienceeducationco.sched.org/subject/Chemistry#.Uh0d-43n8dU>
- Teacher contact information was collected at all of these events and will be used to send CFAITC's annual survey to teachers at the end of 2013. This timeframe will provide teachers with a chance to implement the final drafts of the unit lessons in their classrooms prior to answering survey questions about the educational value of the lessons.

Factsheet:

Project Title: Educational Resources for Teaching Elementary – High School Students about Plant Nutrients

- *Chemistry, Fertilizer, and the Environment* –unit of 5 lessons for 8-12 Grade Students.
- *What Do Plants Need to Grow?* – Unit of 12 lessons for 2-4 Grade Students.

Grant Agreement: # 10-0010-SA

Project Leaders:

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Start Year: 2010

End Year: 2013

Location: Project design was developed with a team of educators and plant nutrient experts from California. Printed copies of the products are being distributed to teachers throughout California. Online copies of the products may be downloaded by teachers throughout the U.S.

County: Project was developed in Sacramento County.

Highlights:

- Two educational units were developed for this project. *Chemistry, Fertilizer, and the Environment* is a five lesson unit for 8th - 12th grade students and *What Do Plants Need to Grow?* is a 2nd – 4th grade unit comprised of twelve lessons. Lessons teach students about plant nutrients and the importance of fertilizer and fertilizer management as well as a connection to how students can apply good

stewardship practices at home by following package instructions when applying lawn, flower, and vegetable fertilizer.

- The newly developed lessons have been presented at teacher workshops and will continue to be promoted. Survey comments from teachers have included:
 - *I believe this is going to be a great way to utilize chemistry in my Ag classes.*
 - *I loved the stand up activity for the periodic table with the yellow ribbons*
 - *It will fit into common core standards and fits perfectly into my solutions unit. Students will be able to utilize the new school garden to do these activities.*
 - *Thank you! It was fun and will be helpful for me as an AP environmental science and biology teacher.*
- Since their release at the end of May, 2013, both plant nutrient education units have been popular with teachers. In three months, 1,059 copies of *What Do Plants Need to Grow?* have been distributed to 2nd – 4th grade teachers and 2,694 copies of *Chemistry, Fertilizer, and the Environment* unit have been distributed to 8th -12th grade teachers. These teachers reach hundreds of thousands of students per year, providing an effective method for increasing student and parent knowledge of food production, plant nutrient, modern farming technology, and environmental connections.

Introduction:

The project was developed to address public lack of knowledge and in some cases misinformation regarding plant nutrient requirements and how those requirements are met in order to feed a growing population with limited resources.

Methods/Management:

The project began by holding curriculum development meetings with classroom teachers and plant nutrient experts. Core concepts were drafted and lesson content was developed by CFAITC staff. Plant nutrient experts from UC Davis, the California Fertilizer Foundation, and the CA Farm Bureau Federation reviewed content for technical accuracy. Lessons were pilot tested in classrooms and aligned to pertinent California Content Standards for Public Schools. Unit lessons are being promoted through newsletters and social media and presented at teacher workshops.

Findings:

Teacher workshop participants have responded positively to the new curriculum and many orders are being filled and mailed to teachers from online and phone requests. Both units are aligned to the Next Generation Science Standards which were released at the end of April, 2013. There are few resources that are aligned to these new standards and CFAITC is helping teachers gain access to up-to-date science curriculum

with engaging hands-on activities that can be completed with basic classroom science equipment.

A. Copy of the Product/Result: Attached

- a. *What Do Plants Need To Grow?:* 2nd – 3rd Grade Unit of Lessons

www.learnaboutag.org/lessonplans/?details=401

- b. *Chemistry, Fertilizer, and the Environment:* 7th – 12th Grade Unit of Lessons

www.learnaboutag.org/lessonplans/?details=404