Solano-Yolo-Sacramento Biotechnology Education Consortium Proposal

July 8, 2005

Meeting organized by:
Judy Kjelstrom (UC Davis Biotechnology Program), David Gilchrist & Barbara Soots (UC Davis-PPGE & Biotech in the Classroom), Jim Dekloe (Solano College), Yen Verhoeven (Vacaville HS), and Tammie Holloway (Solano County ROP)

Biotechnology

There is nothing so powerful as an idea whose time has come.
Victor Hugo

- Biotechnology is no longer a fledging technology....
- It is an economic driving force in the region and the state, as well as the world.
- The Greater Sacramento Region needs to get Organized
Is There a Need for Increased Partnerships?

- The greater Sacramento Valley (Solano County, Yolo County and Sacramento County) is an emerging region for the biotechnology industry especially biomanufacturing.
- The education and training of the workforce is a critical element of this cluster development.
- Is there a need for a coordinated effort among regional high schools, community colleges, and universities as well as biotech companies, WIBs and ROPs to share resources and build partnerships?

We propose a regional network similar to BABEC.

- The Bay Area Biotechnology Education Consortium (BABEC) is a regional network of six county and community partnerships implementing systemic reform in an important area of science education.
- BABEC and its partners are dedicated to raising the level of student awareness and understanding of the science and applications of molecular biology and biotechnology, fields which will increasingly influence their lives and impact their personal and communal decisions.
BABEC

- BABEC and the partnerships are resolved to develop, disseminate, implement and sustain contemporary laboratory-based biotechnology curricula that capture the interest and challenge the capabilities of high school students.
- The model for each partnership is to provide professional development to its teachers, shared equipment and materials for classroom use, and active curricula in DNA manipulation, agarose gel electrophoresis, polymerase chain reaction, bacterial transformation and protein purification.
- BABEC, a 501 (c) (3) non-profit organization, was collectively founded in response to the growing fiscal and logistic needs of the local partnerships and leverages partnership expertise to consolidate activities, reduce expenses, expand funding opportunities, and extend our network to similarly motivated educational and industrial individuals and organizations.

BABEC includes the following partnerships:

- **SF-BASE**: San Francisco Biotechnology Alliance for Science Education
- **GENE CONNECTION**: San Mateo County Biotechnology Education Partnership
- **SCCBEP**: Santa Clara County Biotechnology Education Partnership
- **EBBEP**: East Bay Biotechnology Education Partnership of Alameda/Contra Costa Counties
- **PROBE**: Program for Biotechnology Education in Marin County
- **CISBE**: Consortium of Independent Schools for Biotechnology Education
What are we currently doing?

- Davis
  - UC Davis Biotechnology Program
  - Biotech in the Classroom/Partnership for Plant Genomics Education
  - COSMOS
  - Center for Biophotonics Science and Technology (CBST)
  - Davis Senior High School Biotech Program
- Solano Community College
- Solano County ROP Biotech Programs
  - Vacaville High School Biotech Program
  - Benicia High School
- North Valley & Mountain Biotech Center & American River College
- CSU, Sacramento
- Monsanto, Calgene campus
- Genentech, Vacaville Facility
- Others……

UC Davis Biotechnology Program

Contact: Judy Kjelstrom
Biotechnology: The Tools to Forge a Better Tomorrow

- Founded in 1986
- A special unit of the Office of Research
- Administrative home for the DEB & ADP graduate programs and NIH Biotechnology Training Grant.
  - Fellowships (including industry-funded)
  - Need more corporate internships
- Links Academia to Biotechnology Industries & Gov’t agencies
- Education Source for Students, Teachers, and Community
  - Public Outreach efforts
    - Website
    - Listserv
    - Presentations
  - Summer Technical Short Courses
  - “Train the Trainers” (Co-PI on NSF bioinformatics grant) for CC & HS teachers
  - Advisor for numerous Biotech Programs at high schools, community college and CSUS.

Http://www.biotech.ucdavis.edu
www.deb.ucdavis.edu

DEB

The Designated Emphasis in Biotechnology (DEB) Graduate Program (www.deb.ucdavis.edu). Judith A. Kjelstrom is the program coordinator. The administrative home is the Biotechnology Program (www.biotech.ucdavis.edu), which is located in the Life Sciences Addition building.

- Established in 1997, The DEB is an inter-graduate group program that allows Ph.D. students to receive and be credited for training in the area of biotechnology.

- Currently over 70 students are enrolled and 23 graduate programs are affiliated. Close to 50% of our 15 graduates work in industry.

- DEB Mission:
  - To provide well-coordinated, cross-disciplinary training of PhD students in critical areas of biomolecular technology research.
  - To promote interdisciplinary research environments.
  - To require a 3-6 month internship in a cross-college lab or biotech company.
DEB Curriculum

In addition to the specific graduate program requirements, students wishing to obtain DEB must complete:

1. MCB/ECH 294 Seminar Series (3 quarters)* – Current Progress in Biotechnology - to introduce students to vocabulary.

   *MIC 292 (Industrial Biotechnology: From Discovery to Product) may substitute for 1 quarter. (Novozymes Biotech partnership)

2. MCB 263 - Biotechnology Fundamentals & Application

3. GGG 296 – Scientific Integrity & Professionalism

4. MCB 282 – 3-6 month Internship (usually completed after qualifying exam). Biotech Company is preferred site.

The DEB program offers guidance and assistance in career development, oral presentations, editing of cover letters and curriculum vitae, and acts as ombudsman to help resolve other issues that arise during the student’s tenure.

Advanced Degree Program (ADP) for Corporate Employees

- Dr. Judith A. Kjelstrom, director

This is a unique program to retain outstanding employees by allowing a BS/MS level employee pursue a PhD in a life science major, chemical engineering or materials science engineering at UC Davis, while still being employed by their company.

- It is jointly run by the Biotechnology Program and the Division of Biological Sciences and College of Engineering, in cooperation with Graduate Studies.

- Life Science Majors currently offered: Biochemistry & Molecular Biology; Cell & Developmental Biology; Genetics; Physiology and Plant Biology.

- We are adding Chemical Engineering & Materials Science this summer.

- Participating companies: Berlex, Novozymes, Antibodies Inc. Genentech, Vacaville site may be new partner soon.
PPGE - Partnership for Plant Genomics Education & Biotechnology in the Classroom

Contact: Barbara Soots and Prof. Dave Gilchrist
- Biotechnology Teacher Support Network (BTSN)
- Biotechnology Equipment Loan Program
- Summer Teacher Institutes
- High School and Community College student internships
- Educational Software development

Partnership for Plant Genomics Education & Biotechnology in the Classroom

David Gilchrist, Ph.D.
Barbara Soots
University of California Davis

http://ppge.ucdavis.edu
Biotechnology in the Classroom

Objectives:
Promote the continuing education of secondary teachers, providing them with professional development opportunities to deepen their knowledge of biotechnology.

Provide local teachers with sustained support via biotechnology equipment loan to reproduce their lab experiences during training sessions with their students in the classroom.

Stimulate student interest in modern biology-related careers.

Support a network that encourages collaboration among teachers – Biotechnology Teacher Support Network (BTSN).

Biotechnology in the Classroom

Biotechnology Kits

♦ 9 kits in circulation
  4 Basic Biotech
  3 Transformation
  2 PCR

♦ 43 teachers in 23 schools from Solano, Yolo, and Sacramento counties participate in the program.

♦ Over 4500 students per year
Biotechnology in the Classroom

Evaluation Results

- 86% enjoyed completing the labs
- 70% clearly understood experiment results
- 57% are interested in pursuing this topic of study


Partnership for Plant Genomics Education

funded by the National Science Foundation
partnership with American River and Gavilan Colleges

Objectives:
Create and distribute interactive software and associated curriculum guides for secondary students and teachers that inform them about the essentials of modern plant genomics and its applications.

Offer student biotechnology and genomics internship opportunities that provide students with employment experiences in a laboratory setting.

Offer genomics training for teachers that provides instructional materials and laboratory experiences to deepen knowledge of genomics and biotechnology issues.
Partnership for Plant Genomics Education

*Summer Institutes*

- Nationwide scope
- Genomics and biotech focus
- Lectures from UC Davis and industry scientists combine with lab activities and networking opportunities

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- 150 teachers directly involved in training
- 1135 teachers trained by workshop participants
- 14,608 students currently participating in expts.

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Partnership for Plant Genomics Education
Secondary/Community College Internships

- Application process with targeted recruitment of underrepresented minorities
- Week-long orientation workshop
- 7 weeks in lab with researcher mentor
- Weekly meetings for additional lectures and tours
- Poster session to present research

Partnership for Plant Genomics Education
Interactive Software Development

- Targets secondary through undergraduate level students
- Interactive virtual lab designed to supplement wet lab protocols
- 1700 schools registered users, over 5000 copies distributed
- Currently at work on virtual plant genomics laboratory
COSMOS

- California State Summer School for Mathematics and Science (legislatively mandated)
- Contact: Paul Feldstein
- Summer In-Residence Biotechnology Program for High Achieving High School students
- Other topics include: Computers and Robotics, Mathematics, Environmental Science, Biomedical Science

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COSMOS

- 4 week intensive Biotech experience including background on sciences underlying Biotech, examples of current applications of Biotech, and Biotech related lab experiments
- Experiments using PCR for DNA fingerprinting, protein mutagenesis, expression and purification, transgenic plants, viruses as vectors, etc.
- Field trips to local Biotech related facilities
COSMOS

- Issues for the future
  - Insuring appropriate students and teachers are familiar with COSMOS opportunities
  - Identifying new sources of equipment, experiments, and expertise
  - Identifying new field trip opportunities
  - Insuring continued funding from the state with or without extramural funds

CBST
( NSF Center for Biophotonics Science and Technology)

- Contacts:
  Marco Molinaro (mmolinaro@ucdavis.edu)
  Pam Castori (pscastori@ucdavis.edu)

- High School program – focus on practical hands-on science education, especially biophotonics
- Community College Technician Specialization
- Internships
- Undergraduate and graduate courses
- Seminars
**CBST**
(NSF Center for Biophotonics Science and Technology)

**Education**

**Knowledge Transfer**

**Science and Technology**

*Explore, Advance and Promote the Field of Biophotonics*

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**SCIENCE & TECHNOLOGY MISSION**

*Development and Application of Photon-Based Tools for the Life Sciences and Medicine*

Ultimate goal is to address grand challenges such as:

- Imaging the structure and dynamics of proteins and protein complexes
- Sensing biomarkers at the single molecule level of sensitivity
- Diagnosing and treating disease using photons
CBST - We Are Interdisciplinary Team Science

*11 research physicians
CBST HQ at Med Center

*19 bioscientists

*56 physicists, chemists

* 8 engineers

UG/G students (2004/05)
Engineering: 24
Physical Science: 49
Biological Science: 17
Computer Science: 1
Business: 6
Human Development: 16

* MD, PhD, and MD/PhD faculty

EDUCATION MISSION

Create the human resources and the knowledge base to fuel the future of Biophotonics

- Enable diverse students to pursue productive careers in science with an emphasis on biophotonics
- Engage the public in understanding the field of, and opportunities presented by biophotonics
- Create and fuel the online engine for biophotonics education
CBST Education Map

After-School programs and curricula

4-H cross-age teaching

Research Academies

Teacher Prof. Development

Science courses (3+)

CC biophotonics technician specialization

Research internships (summer, year)

Upgrade as mentors

Hum.Dev. Courses (2)

Designated Emphasis Courses (2+)

Public Outreach events

Biophotonics World - Education

URG Supplement STC-wide

U/Grad Prof. Development programs

PDoc

Grad

Ugrad

9-12

K-5

Resources/ Public

UCDMC: Center for Virtual Care

Contact: Betsy Bencken, MS
Clinical Instructor
Chief Administrative Officer
Department of Anesthesiology & Pain Medicine
Center for Virtual Care
4150 V Street Suite 1200
Sacramento, CA 95817
bbencken@ucdavis.edu
CVC: 916-734-4708
http://www.ucdmc.ucdavis.edu/healthprofessionals/virtual_care/
UCDMC - Center for Virtual Care

- Human Patient Simulator
- PediaSim
- Infant simulator
- Emergency Care Simulator
- ExamSim
- Robotic Minimally Invasive Surgery System
- Virtual Surgical Trainers
- Cardiac Catheter & Stent Simulation

Simulation Participants

- Medical Students
- Residents
- Fellows
- Nursing
- Paramedics
- Respiratory Technicians
- Pharmacists
- Continuing Education
- Community / High Schools
Davis Senior High School

- Contact: Ann Moriarty
- Outstanding Biotech Program (ROP-funded)
- Focus (1 year program): DNA, Proteins, Use of search tools in Bioinformatics
- Research internships at UC Davis and local companies
- Recipient of Amgen’s Teacher of the Year (2004) – nominated by Dr. Kjelstrom
  – $10K in unrestricted funds

Solano Community College

- Contacts: Dave Redfield, Jim Dekloe and Ed Re
Edward Teller Education Center

- Contact: Stan Hitomi
- Train the Trainer Programs for High School Teachers
- Equipment
- Cheerleading

Edward Teller Education Center

University of California Collaborative

- University of California - Office of the President
- University of California, Davis
- University of California, Merced
- Lawrence Livermore National Laboratory
**BIG Science**

“Building Bridges from the Laboratory to the Classroom”

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**Strategic Development Model**

1. **BIG SCIENCE** - Scientist & teacher team take cutting-edge research and develop a standards-based curriculum.

2. **Instructional Strategies** - Develop inquiry and project-based model to deliver instruction.

3. **Professional Development** - Provide training based upon the national standards for teacher professional development.

4. **Evaluation** - Educational & classroom research in collaboration with UC Davis School of Education.
Teacher Professional Development Model

Level - I: Basic knowledge & skills
- Science Associate
- 3 - day program
- Standards-based

Level - II: Advanced knowledge & skills
- Science Fellow
- 5 - day program
- Standards-based

Level - III: Pre - Internship
- Research Associate
- 5 - day program
- Research skills

Level - IV: Internship - Research Lab
- Research Fellow
- 120 hours mentored research

ETEC: Biotechnology Teacher Research Academy

Level - I
- pGLO Transformation
- Protein Purification
- DNA Fingerprinting

Level - II
- PCR
- Protein Fingerprinting
- Sequencing
- Bio-informatics

Level - III
- Pre-Internship
- Research Skills

Level - IV
- Research Internship
- Student Research
Biotechnology
Level - I

Solano County Office of Education
Regional Occupational Program

- ROP Contact: Susan Labrecque
- Biotechnology classes offered at:
  - Vacaville High School – Yen Verhoeven
  - Rodriguez High School
  - Benicia High School – Ray Lewis
- Meets “d” lab requirement for UC ‘a-g’
Vacaville High School (w/ Solano ROP)

- Contact: Yen Verhoeven

VHS Biotechnology ROP Program
About VHS Biotechnology

- One year ROP course for Juniors and Seniors
- Program has been in place for two years
- Supported by a $50,000 grant from the Genentech Foundation. An additional $15,000 was given for professional development for this year.
- Additional support, equipment and supplies from Solano County ROP
- Equipment and training provided by PPGE at UC Davis, EBBEP, Jim DeKloe, and Ellyn Daugherty
- Partnerships with Solano Community College, Large Scale Biology Corporation, UC Davis Partnership for Plant Genomics (PPGE), East Bay Biotechnology Education Program (EBBEP) and Solano County ROP, Genentech Vacaville, and Alza

Course of Study

- Labs include:
  - PCR, restriction enzyme digests, DNA and protein gel electrophoresis, protein purification, basic microbiology
- Soft Skills
  - Laboratory safety, lab notebook, web design, good work ethic and behavior, resume-writing and job-hunting strategies
- Field trips and Guest Speakers
VHS Biotech’s Future Goals

- Protein-based labs using spectrophotometry and SDS PAGE, ELISA, Antigen assay
- Eukaryotic tissue culture
- Bioinformatics unit
- Outreach to all life science courses in our district
- Internships to all Biotechnology students
- Partnerships with biotechnology industries in our area

Programs/Support At Solano County

- 3 Biotechnology programs in Solano County: Vacaville HS, Benecia HS, Rodriguez HS
- Development towards introducing Biotech into first year of Life Sciences
- BABEC – equipment loan and training, equipment donation
- PPGE – equipment loan and training/ BTSN – Biotechnology Teacher Support Network
- Support from Solano Community College, UC Davis, Sacramento State
- Support from private companies: Genentech, BioRad, Alza
- Consultation by Ellyn Daugherty
Biotechnology Equipment

- Equipment loan program for each county in small groups/clusters
  - Allows Biotech equipment to be at one site for ¼ of the year
- Equipment donation program/repository
  - Donated equipment would be held in a repository and distributed among the high schools
- Purchasing chemicals/consummables in bulk
- Grants for equipment/new facilities/supplies

Biotechnology Teacher Support

- Training – for both higher level labs as well as basic “shoestring” biotechnology labs that may be integrated into the curriculum
  - Information and funding to attend special workshops and conferences
  - “Best Practices Days” held during the summer - sharing sessions between other biotech and biology teachers
- Support for beginning Biotechnology teachers
  - Advisory committees
  - Network with other Biotech teachers, Community Colleges, and Universities
  - Sharing of course outlines, labs, worksheets, etc…
  - Visits to other biotechnology programs in the area
Collaboration

- Collaboration – between industry and research laboratories
  - Internships
  - Field trips
  - Guest Speakers
- Advisory committee – for each county or area
  - Gives advice on curriculum improvement
  - Support and help for specific questions for labs
  - Helps represent the importance of Biotech in the community as well as provide support for curriculum changes and approvals
  - Helps teacher with training, or advice on how high schools can foster the development of the Biotech workforce
- Articulation to the colleges
- Partnerships with other research institutions for grants
- Mobile labs – brings and spreads the curriculum to other teachers, campuses and classes

Benicia High School (Solano ROP)

- Contact: Ray Lewis
Benicia High School

- **Current Situation:**
  - One year course in Biotech-Juniors and Seniors
  - One section offered each of past two years
  - District support ~ $100 per year/class
  - Parent Donations total ~ $400 per year/class
  - BHS is EBBEP Cluster Center for Solano County
  - Equipment and training support from BABEC/EBBEP, BioRad, City of Benicia, UC Davis, Ellyn Daugherty, Jim DeCloe

Benicia High School

- **Labs include:**
  - Bacteriology (sterile technique)
  - DNA extraction-human cheek cell
  - Agarose Gel Electrophoresis
  - Polyacrylamide Gel Electrophoresis
  - Bacterial Transformation (pGLO)
  - Purification of GFP by HIC
Benicia High School

Labs (continued)
- GMO food identification (BioRad Kit)
- Spectrophotometry (VIS)
  – protein with coomassie
  – pipette accuracy
- Elisa (BioRad Kit)
- Restriction digest of Lambda DNA
- Detection and isolation of bioactive compounds in plants using TLC

Benicia High School

Labs (continued)
- PCR
  Alu
  D1S80
  MtDNA
  Cycle sequencing reaction

Computer Work
- Image J software from NIH
- BioServers software accessed through Cold Spring Harbor website
- PowerPoint Presentations
Benicia High School

- Plans for the future:
  - Add Protein labs
    - UV Spectrophotometry
    - Ion Exchange Chromatography/Assay
    - Affinity Chromatography
    - Size Exclusion Chromatography/Assay
    - SDS PAGE separation of proteins
  - Implement standard lab notebook procedure
  - Develop student competence in preparation of lab reagents
  - Bioinformatics component
  - Develop and implement standard curriculum in county

Marysville High School

- Vera N. Bryan  vbryan@mjusd.net
- Biotechnology 1-2
  - Semester Course modeled after San Mateo's Award Winning Program.
  - For the 2004-2005 school year, Marysville High School was one of the many schools field testing Ellen Daughtery’s textbook: Biotechnology: Science For a New Millennium.

**Basic Curriculum:**
- Biotechnology Past/Present
- DNA and Protein Structure/Function
- Assay Development
- Recombinant DNA Technology
- Transformation/Genetic Engineering
- Scale-up, Manufacturing, Marketing
Biotechnology Course Outline
Marysville High School

- Biotechnology Past/Present
- DNA and Protein Structure/Function
- Assay Development
- Recombinant DNA Technology
- Transformation/Genetic Engineering
- Scale-up, Manufacturing, Marketing

Funding
- SSP Grant

North Valley and Mountain Biotechnology Center & American River College (ARC)

- Contacts: Jeffrey O’Neal, Carey Kopay and Ken Kubo
  - NSF “Train-the Trainer” grant in Bioinformatics
  - 2005 Teen Biotech Challenge
  - Workshops for HS Teachers and CC Faculty
  - Biotech AS Degree and Certificate
NVMBC – Workforce Development

- California state funded Economic and Workforce Development Program center
  - Community college support center for biotechnology vocational training programs
  - Supporting the biotech industry through education and training within the region
  - Providing some specialty education events and public information
  - North and Far North Region

NVMBC – “Train the Trainers” NSF Grant

- 2003 – 2005 NSF Bioinformatics Training Grant for Community College Faculty
- Collaborative effort between ARC & UCD
- Focuses on integrating bioinformatics curriculum across biological science disciplines.
- Additional NSF Grant proposals for programs to extend training to high school teachers
- www.arc.losrios.edu/~biotech/NSF
NVMBC – Outreach Efforts

■ Teen Biotech Challenge
  – High School contest promoting biotech awareness
  – Identify high school partnerships & local biotech programs
  – Opportunity to bring together colleges, schools & teachers, and industry partners.
    – [www.arc.losrios.edu/TBC](http://www.arc.losrios.edu/TBC)

NVMBC – Classroom Outreach

■ Classroom support for local teachers & high school biotech programs
■ Assist in curriculum development & implementation
■ Limited availability of classroom resource and materials for teachers
■ Supporting partner for *Partnership for Plant Genomics Education* with UCD-CEPRAP
  NSF Grant includes teacher training workshops.
American River College Biotechnology Program

- ARC Programs
  - A.S. Degree, Biotechnology
  - Bioinformatics Certificate
  - Biotechnology Certificate

- Online classes available, open enrollment can include high school students
  - Introduction to Bioinformatics (BioT305)
  - Biotechnology & Society (BioT307)

- [www.arc.losrios.edu/~biology/biotech](http://www.arc.losrios.edu/~biology/biotech)

NVMBC – Resources & Limitations

- Established partnerships with regional universities & schools.

- Access to equipment & funding opportunities to support biotech education programs.

- Limited budget to support individual activities.

- Personnel limitations for classroom support & material loaning program.

- Primary funding focus is community colleges. High school activities are secondary, depending on resources.
CSUS, Sacramento

- Contact: Prof Nick Ewing, chair of Biological Sciences
- MBIG- Molecular Biology Integrative Group for training
- Science Teacher Training

Genentech

- Contacts: Kimber Hoey, Paige Lloyd, Heidi Belforte
  - Student internship/co-op programs
  - Genentech Scholars Program (High School, Community College, Universities, Graduate Level)
  - Faculty Rotation Program
  - Bio-Manufacturing Training Partnership with Skyline and Ohlone Colleges, Alameda and San Mateo County Workforce Investment Boards
  - Advisory committee Solano and American River Colleges Biotech Programs
Monsanto, Calgene Campus

- Contacts: Beth Savidge, Byron Froman and Ken Gruys
  - Local high school Biotech Advisory Committees
  - Scholarships/Awards
  - Career Days
    - Secondary school and college level
  - Guest speakers
  - Extensive on-site tours
    - Regional schools/clubs
    - Local and foreign government officials
  - Monsanto Fund Grants
    - Explorit Science Center
  - Biotechnology curriculum available for schools

So…We are all doing great things, so where do we need help?

- Training
- Equipment
- Curriculum
- Guest speakers
- Internships for teachers and students
- Scholarships/Fellowships/Grants
- Networking/Support
- Career Explorations
Should we move Forward…????

- If so, what are the next steps ????
  - Contact BABEC for guidance
  - Create a new model (loosely based on BABEC)
  - Logistics – Home Base???
  - Mobile Van
  - Website
  - Kits
  - Grant writing
  - Increased Internships/Job shadowing

Membership

Proposal:
- Founding Members - Biotechnology Education Programs in the region and their Advisory Committee members as well as anyone attending this kick-off meeting.
- Distribute Contact List to all members
- New members will be added as the effort expands
- Create MOU
- Create Website
What should we call ourselves?

- SSYBEC “Si-Bec”
- SABEC “Say-Bec”
  (Sacramento Area Biotech Education Consortium)
- Other ideas????

Thanks for Coming

- If we create partnerships, we can accomplish great things
- If you have additional comments or ideas, contact me:
- Please contact me at: jakjelstrom@ucdavis.edu
  telephone: 530-752-8228