Cover Page for Proposal Submitted to the National Aeronautics and Space Administration

NASA Proposal Number

09-EPOESS09-0032

NASA PROCEDURE FOR HANDLING PROPOSALS

This proposal shall be used and disclosed for evaluation purposes only, and a copy of this Government notice shall be applied to any reproduction or abstract thereof. Any authorized restrictive notices that the submitter places on this proposal shall also be strictly complied with. Disclosure of this proposal for any reason outside the Government evaluation purposes shall be made only to the extent authorized by the Government.

SECTION I - Proposal Information

Principal Investigator	E-mail Address	Phone Number
Tara Firenzi	**tara.firenzi@pcsed.org**	**831-295-3252**

Street Address (1)	Street Address (2)
255 Swift St	

City	State / Province	Postal Code	Country Code
Santa Cruz	**CA**	**95060-6225**	**US**

Proposal Title : **A Big History of the Universe for Secondary Education**

Proposed Start Date	Proposed End Date	Total Budget	Year 1 Budget	Year 2 Budget	Year 3 Budget	Year 4 Budget
01 / 01 / 2010	**12 / 31 / 2012**	**220368.00**	**68339.00**	**69220.00**	**82809.00**	**0.00**

SECTION II - Application Information

NASA Program Announcement Number	NASA Program Announcement Title
NNH09ZDA001N-EPOESS	**Opportunities In Education and Public Outreach For Earth and Space Science**

For Consideration By NASA Organization *(the soliciting organization, or the organization to which an unsolicited proposal is submitted)*

NASA , Headquarters , Science Mission Directorate , Cross Division

Date Submitted	Submission Method	Grants.gov Application Identifier	Applicant Proposal Identifier
06 / 30 / 2009	**Electronic Submission Only**		

Type of Application	Predecessor Award Number	Other Federal Agencies to Which Proposal Has Been Submitted
New		

International Participation	Type of International Participation
No	

SECTION III - Submitting Organization Information

DUNS Number	CAGE Code	Employer Identification Number (EIN or TIN)	Organization Type
010171226	**5JNZ2**	**770485136**	**2A**

Organization Name (Legal Name)	Company Division
PACIFIC COLLEGIATE SCHOOL	

Organization DBA Name	Division Number
PACIFIC COLLEGIATE CHARTER SCHOOL	

Street Address (1)	Street Address (2)
255 SWIFT ST	

City	State / Province	Postal Code	Country Code
SANTA CRUZ	**CA**	**950606225**	**USA**

SECTION IV - Proposal Point of Contact Information

Name	Email Address	Phone Number
Tara Firenzi	**tara.firenzi@pcsed.org**	**831-295-3252**

SECTION V - Certification and Authorization

Certification of Compliance with Applicable Executive Orders and U.S. Code

By submitting the proposal identified in the Cover Sheet/Proposal Summary in response to this Research Announcement, the Authorizing Official of the proposing organization (or the individual proposer if there is no proposing organization) as identified below:

- certifies that the statements made in this proposal are true and complete to the best of his/her knowledge;
- agrees to accept the obligations to comply with NASA award terms and conditions if an award is made as a result of this proposal; and
- confirms compliance with all provisions, rules, and stipulations set forth in the two Certifications and one Assurance contained in this NRA (namely, (i) the Assurance of Compliance with the NASA Regulations Pursuant to Nondiscrimination in Federally Assisted Programs, and (ii) Certifications, Disclosures, and Assurances Regarding Lobbying and Debarment and Suspension.

Willful provision of false information in this proposal and/or its supporting documents, or in reports required under an ensuing award, is a criminal offense (U.S. Code, Title 18, Section 1001).

Authorized Organizational Representative (AOR) Name	AOR E-mail Address	Phone Number
Camilla Boolootian	**Camilla.boolootian@pcsed.org**	**831-479-7785**

AOR Signature *(Must have AOR's original signature. Do not sign "for" AOR.)* **Date**

PI Name : **Tara Firenzi**			**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**			**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**			

SECTION VI - Team Members

Team Member Name	E-mail Address	Phone Number
Tara Firenzi	**tara.firenzi@pcsed.org**	**831-295-3252**
Organization Name	Team Member Role	International Participation
Pacific Collegiate School	**PI**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
DAVID CHRISTIAN	**DAVID.CHRISTIAN@MQ.EDU.AU**	**2-9810-0918**
Organization Name	Team Member Role	International Participation
MACQUARIE UNIVERSITY	**Collaborator**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Zoe Buck	**zbuckster@gmail.com**	**818-395-7435**
Organization Name	Team Member Role	International Participation
UC Santa Cruz	**Graduate/Undergraduate Student**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Darrell Steely	**darrell.steely@gmail.com**	**831-325-5714**
Organization Name	Team Member Role	International Participation
Pacific Collegiate School	**Co-I**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Joel Primack	**joel@scipp.ucsc.edu**	**831-459-2580**
Organization Name	Team Member Role	International Participation
University of California, Santa Cruz	**Co-I**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Joel Tarbox	**joel.tarbox@pcsed.org**	**831-479-7785**
Organization Name	Team Member Role	International Participation
Pacific Collegiate School	**Co-I**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Nancy Abrams	**nancysview@gmail.com**	**831-425-1194**
Organization Name	Team Member Role	International Participation
	Co-I	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Doris Ash	**dash5@ucsc.edu**	**831-459-5549**
Organization Name	Team Member Role	International Participation
University of California Santa Cruz	**Collaborator**	**No**
U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

Team Member Name	E-mail Address	Phone Number
Solana Pyne	**smpyne@gmail.com**	**646-351-2587**

Organization Name	Team Member Role	International Participation
	Consultant	**No**

U.S. Government Agency Participation	U.S. Government Agency	Total Funds Requested
No		**0.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**

Proposal Title : **A Big History of the Universe for Secondary Education**

SECTION VII - Project Summary

This proposal is to develop secondary school level curricula including videos in the fields of cosmology, astrobiology and world history in order to harness the very latest developments in these closely connected fields to expand the thinking of young students as early as possible. This project fulfills NASA¿s goal of sharing "the story, the science, and the adventure of NASA¿s scientific explorations of our home planet, the solar system, and the universe."

Over the past decade, world historians and social science educators have come to realize that the origin of our universe is the beginning of our human story. Though the incorporation of these ideas into secondary curricula is not yet widespread, well respected efforts such as "World History for Us All," a project of the National Center for History in Schools at UCLA, have strongly advocated for the incorporation of the history of the universe in world history curricula. Books like David Christian¿s Maps of Time: An Introduction to Big History (2005), suggest that these efforts should and will become a more significant part of both history and science instruction in secondary schools in the near future, making instruction in both areas more interdisciplinary and thus more effective.

In scientific fields, of course, the importance of the origins of the universe has long been understood. Bringing us to a new level of understanding on the subject of these origins, University of California, Santa Cruz Professor Joel Primack and UCSC lecturer Nancy Abrams have recently introduced a number of new ideas about the connections between advanced scientific theories and the historical importance of the origins of the universe as discussed in their book, The View From the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos (2006). The authors incorporated a significant amount of ground-breaking cosmological research done by co-author Joel Primack and other cosmologists, and this research represents some of the most important work being done in astrophysics today. Abrams and Primack also tied in fundamental discoveries in other aspects of astronomy, evolutionary biology, geology, planetary science, geology, and archaeology.

This proposal brings together the cutting-edge scientific theories and research discussed in The View from the Center of the Universe and the themes of ¿Big History¿ that are becoming increasingly important in world history education at the secondary level. Specifically, three half-hour videos would be produced for classroom use at the secondary level, in various science and world history classrooms. These videos would incorporate visual data from simulations conducted by Joel Primack and other cosmologists in order to provide junior high and high school students with access to some of the most up-to-date and exciting visual information available about the universe. In addition to these videos, ancillary standards-based curricular materials would also be developed by a team of teachers from Pacific Collegiate School¿a school recognized by all available measures as one of the nation¿s best public, college-preparatory high schools¿along with the help of UCSC Education faculty and graduate student researchers.

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**

Proposal Title : **A Big History of the Universe for Secondary Education**

SECTION VIII - Other Project Information

Proprietary Information

Is proprietary/privileged information included in this application?

Yes

International Collaboration

Does this project involve activities outside the U.S. or partnership with International Collaborators?

No

Principal Investigator	Co-Investigator	Collaborator	Equipment	Facilities
No	**No**	**No**	**No**	**No**

Explanation :

NASA Civil Servant Project Personnel

Are NASA civil servant personnel participating as team members on this project (include funded and unfunded)?

No

Fiscal Year	Fiscal Year	Fiscal Year	Fiscal Year	Fiscal Year
Number of FTEs	Number of FTEs	Number of FTEs	Number of FTEs	Number of FTEs

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**

Proposal Title : **A Big History of the Universe for Secondary Education**

SECTION VIII - Other Project Information

Environmental Impact

Does this project have an actual or potential impact on the environment?	Has an exemption been authorized or an environmental assessment (EA) or an environmental impact statement (EIS) been performed?
No	**No**

Environmental Impact Explanation:

Exemption/EA/EIS Explanation:

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**

Proposal Title : **A Big History of the Universe for Secondary Education**

SECTION VIII - Other Project Information

Historical Site/Object Impact

Does this project have the potential to affect historic, archeological, or traditional cultural sites (such as Native American burial or ceremonial grounds) or historic objects (such as an historic aircraft or spacecraft)?

No

Explanation:

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**

Proposal Title : **A Big History of the Universe for Secondary Education**

SECTION IX - Program Specific Data

Question 1 : Short Title:

Answer: A Big History of the Universe

Question 2 : Type of institution:

Answer: Educational Organization

Question 3 : Will any funding be provided to a federal government organization including NASA Centers, JPL, other Federal agencies, government laboratories, or Federally Funded Research and Development Centers (FFRDCs)?

Answer: No

Question 4 : Is this Federal government organization a different organization from the proposing (PI) organization?

Answer: N/A

Question 5 : Does this proposal include the use of NASA-provided high end computing?

Answer: No

Question 6 : Research Category:

Answer: 1) Theory/computer modeling

Question 7 : Team Members Missing From Cover Page:

Answer:

Question 8 : This proposal contains information and/or data that are subject to U.S. export control laws and regulations including Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR).

Answer: No

Question 9 : I have identified the export-controlled material in this proposal.

Answer: N/A

Question 10 : I acknowledge that the inclusion of such material in this proposal may complicate the government's ability to evaluate the proposal.

Answer: N/A

Question 11 : Portfolio Area:

Answers :

Elementary and Secondary Education

Question 12 : Science Focus:

Answers :

Astrophysics

Planetary Science

Earth Science

Question 13 : Does the proposal include any funds that would be used to support civil servant or contract personnel at any NASA Center, or federal agency, or Federally Funded Research and Development Centers such as JPL or Los Alamos?

Answer: No

Question 14 : If the lead institution is a for-profit organization, is there any fee or other cost, that would preclude use of a grant as an award funding mechanism.

Answer: No

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Cumulative Budget

Budget Cost Category	Funds Requested ($)				
	Year 1 ($)	Year 2 ($)	Year 3 ($)	Year 4 ($)	Total Project ($)
A. Direct Labor - Key Personnel	**51727.00**	**51727.00**	**51727.00**	**0.00**	**155181.00**
B. Direct Labor - Other Personnel	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Total Number Other Personnel	**0**	**0**	**0**	**0**	**0**
Total Direct Labor Costs (A+B)	**51727.00**	**51727.00**	**51727.00**	**0.00**	**155181.00**
C. Direct Costs - Equipment	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
D. Direct Costs - Travel	**0.00**	**0.00**	**5000.00**	**0.00**	**5000.00**
Domestic Travel	**0.00**	**0.00**	**2000.00**	**0.00**	**2000.00**
Foreign Travel	**0.00**	**0.00**	**3000.00**	**0.00**	**3000.00**
E. Direct Costs - Participant/Trainee Support Costs	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Tuition/Fees/Health Insurance	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Stipends	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Travel	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Subsistence	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Other	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Number of Participants/Trainees					**0**
F. Other Direct Costs	**16612.00**	**17493.00**	**26082.00**	**0.00**	**60187.00**
Materials and Supplies	**0.00**	**0.00**	**3000.00**	**0.00**	**3000.00**
Publication Costs	**0.00**	**0.00**	**1000.00**	**0.00**	**1000.00**
Consultant Services	**2000.00**	**2000.00**	**2000.00**	**0.00**	**6000.00**
ADP/Computer Services	**0.00**	**0.00**	**200.00**	**0.00**	**200.00**
Subawards/Consortium/Contractual Costs	**12612.00**	**12993.00**	**13382.00**	**0.00**	**38987.00**
Equipment or Facility Rental/User Fees	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Alterations and Renovations	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Other	**2000.00**	**2500.00**	**6500.00**	**0.00**	**11000.00**
G. Total Direct Costs (A+B+C+D+E+F)	**68339.00**	**69220.00**	**82809.00**	**0.00**	**220368.00**
H. Indirect Costs	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
I. Total Direct and Indirect Costs (G+H)	**68339.00**	**69220.00**	**82809.00**	**0.00**	**220368.00**
J. Fee	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
K. Total Cost (I+J)	**68339.00**	**69220.00**	**82809.00**	**0.00**	**220368.00**
Total Cumulative Budget					**220368.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2010	**12 / 31 / 2010**	**Project**	**1**

A. Direct Labor - Key Personnel

Name	Project Role	Base Salary ($)	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
Firenzi, Tara	**PI**	**0.00**			**2**	**14878.00**	**202.00**	**15080.00**
Tarbox, Joel	**CO-I**	**0.00**			**2**	**11445.00**	**245.00**	**11690.00**
Steely, Darrell	**CO-I**	**0.00**			**2**	**12212.00**	**245.00**	**12457.00**
Abrams, Nancy	**CO-I**	**0.00**			**2**	**12500.00**	**0.00**	**12500.00**
							Total Key Personnel Costs	**51727.00**

B. Direct Labor - Other Personnel

Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
0	**Total Number Other Personnel**					**Total Other Personnel Costs**	**0.00**
						Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)	**51727.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2010	**12 / 31 / 2010**	**Project**	**1**

C. Direct Costs - Equipment

Item No.	Equipment Item Description	Funds Requested ($)
	Total Equipment Costs	**0.00**

D. Direct Costs - Travel

	Funds Requested ($)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)	**0.00**
2. Foreign Travel	**0.00**
Total Travel Costs	**0.00**

E. Direct Costs - Participant/Trainee Support Costs

		Funds Requested ($)
1. Tuition/Fees/Health Insurance		**0.00**
2. Stipends		**0.00**
3. Travel		**0.00**
4. Subsistence		**0.00**
Number of Participants/Trainees:	**Total Participant/Trainee Support Costs**	**0.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2010	**12 / 31 / 2010**	**Project**	**1**

F. Other Direct Costs

	Funds Requested ($)
1. Materials and Supplies	**0.00**
2. Publication Costs	**0.00**
3. Consultant Services	**2000.00**
4. ADP/Computer Services	**0.00**
5. Subawards/Consortium/Contractual Costs	**12612.00**
6. Equipment or Facility Rental/User Fees	**0.00**
7. Alterations and Renovations	**0.00**
8 . Other: **Props, costumes, etc.**	**2000.00**
Total Other Direct Costs	**16612.00**

G. Total Direct Costs

	Funds Requested ($)
Total Direct Costs (A+B+C+D+E+F)	**68339.00**

H. Indirect Costs

	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
Cognizant Federal Agency:		**Total Indirect Costs**	**0.00**

I. Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Costs (G+H)	**68339.00**

J. Fee

	Funds Requested ($)
Fee	**0.00**

K. Total Cost

	Funds Requested ($)
Total Cost with Fee (I+J)	**68339.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2011	**12 / 31 / 2011**	**Project**	**2**

A. Direct Labor - Key Personnel

Name	Project Role	Base Salary ($)	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
Firenzi, Tara	**PI**	**0.00**			**2**	**14878.00**	**202.00**	**15080.00**
Steely, Darrell	**CO-I**	**0.00**			**2**	**12212.00**	**245.00**	**12457.00**
Abrams, Nancy	**CO-I**	**0.00**			**2**	**12500.00**	**0.00**	**12500.00**
Tarbox, Joel	**CO-I**	**0.00**			**2**	**11445.00**	**245.00**	**11690.00**
							Total Key Personnel Costs	**51727.00**

B. Direct Labor - Other Personnel

Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
0	**Total Number Other Personnel**					**Total Other Personnel Costs**	**0.00**
						Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)	**51727.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2011	**12 / 31 / 2011**	**Project**	**2**

C. Direct Costs - Equipment

Item No.	Equipment Item Description	Funds Requested ($)
	Total Equipment Costs	**0.00**

D. Direct Costs - Travel

	Funds Requested ($)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)	**0.00**
2. Foreign Travel	**0.00**
Total Travel Costs	**0.00**

E. Direct Costs - Participant/Trainee Support Costs

		Funds Requested ($)
1. Tuition/Fees/Health Insurance		**0.00**
2. Stipends		**0.00**
3. Travel		**0.00**
4. Subsistence		**0.00**
Number of Participants/Trainees:	**Total Participant/Trainee Support Costs**	**0.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2011	**12 / 31 / 2011**	**Project**	**2**

F. Other Direct Costs

	Funds Requested ($)
1. Materials and Supplies	**0.00**
2. Publication Costs	**0.00**
3. Consultant Services	**2000.00**
4. ADP/Computer Services	**0.00**
5. Subawards/Consortium/Contractual Costs	**12993.00**
6. Equipment or Facility Rental/User Fees	**0.00**
7. Alterations and Renovations	**0.00**
8 . Other: **Props, costumes, etc.**	**2000.00**
9 . Other: **Stipends for teachers (field tests)**	**500.00**
Total Other Direct Costs	**17493.00**

G. Total Direct Costs

	Funds Requested ($)
Total Direct Costs (A+B+C+D+E+F)	**69220.00**

H. Indirect Costs

	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
Cognizant Federal Agency:		**Total Indirect Costs**	**0.00**

I. Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Costs (G+H)	**69220.00**

J. Fee

	Funds Requested ($)
Fee	**0.00**

K. Total Cost

	Funds Requested ($)
Total Cost with Fee (I+J)	**69220.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2012	**12 / 31 / 2012**	**Project**	**3**

A. Direct Labor - Key Personnel

Name	Project Role	Base Salary ($)	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
Firenzi, Tara	**PI**	**0.00**			**2**	**14878.00**	**202.00**	**15080.00**
Steely, Darrell	**CO-I**	**0.00**			**2**	**12212.00**	**245.00**	**12457.00**
Abrams, Nancy	**CO-I**	**0.00**			**2**	**12500.00**	**0.00**	**12500.00**
Tarbox, Joel	**CO-I**	**0.00**			**2**	**11445.00**	**245.00**	**11690.00**
							Total Key Personnel Costs	**51727.00**

B. Direct Labor - Other Personnel

Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
0	**Total Number Other Personnel**					**Total Other Personnel Costs**	**0.00**
						Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)	**51727.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2012	**12 / 31 / 2012**	**Project**	**3**

C. Direct Costs - Equipment

Item No.	Equipment Item Description	Funds Requested ($)
	Total Equipment Costs	**0.00**

D. Direct Costs - Travel

	Funds Requested ($)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)	**2000.00**
2. Foreign Travel	**3000.00**
Total Travel Costs	**5000.00**

E. Direct Costs - Participant/Trainee Support Costs

		Funds Requested ($)
1. Tuition/Fees/Health Insurance		**0.00**
2. Stipends		**0.00**
3. Travel		**0.00**
4. Subsistence		**0.00**
Number of Participants/Trainees:	**Total Participant/Trainee Support Costs**	**0.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
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Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type :	Budget Period :
01 / 01 / 2012	**12 / 31 / 2012**	**Project**	**3**

F. Other Direct Costs

	Funds Requested ($)
1. Materials and Supplies	**3000.00**
2. Publication Costs	**1000.00**
3. Consultant Services	**2000.00**
4. ADP/Computer Services	**200.00**
5. Subawards/Consortium/Contractual Costs	**13382.00**
6. Equipment or Facility Rental/User Fees	**0.00**
7. Alterations and Renovations	**0.00**
8 . Other: **Music rights**	**3000.00**
9 . Other: **Distribution costs**	**500.00**
10 . Other: **Workshop for Teachers**	**3000.00**
Total Other Direct Costs	**26082.00**

G. Total Direct Costs

	Funds Requested ($)
Total Direct Costs (A+B+C+D+E+F)	**82809.00**

H. Indirect Costs

	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
	0.00	**0.00**	**0.00**
Cognizant Federal Agency:		**Total Indirect Costs**	**0.00**

I. Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Costs (G+H)	**82809.00**

J. Fee

	Funds Requested ($)
Fee	**0.00**

K. Total Cost

	Funds Requested ($)
Total Cost with Fee (I+J)	**82809.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type : **Project**	Budget Period : **4**

A. Direct Labor - Key Personnel

Name	Project Role	Base Salary ($)	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
Firenzi, Tara	PI	0.00				0.00	0.00	0.00
						Total Key Personnel Costs		0.00

B. Direct Labor - Other Personnel

Number of Personnel	Project Role	Cal. Months	Acad. Months	Summ. Months	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
0	Total Number Other Personnel				Total Other Personnel Costs		0.00
						Total Direct Labor Costs (Salary, Wages, Fringe Benefits) (A+B)	0.00

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type : **Project**	Budget Period : **4**

C. Direct Costs - Equipment

Item No.	Equipment Item Description	Funds Requested ($)
	Total Equipment Costs	**0.00**

D. Direct Costs - Travel

	Funds Requested ($)
1. Domestic Travel (Including Canada, Mexico, and U.S. Possessions)	**0.00**
2. Foreign Travel	**0.00**
Total Travel Costs	**0.00**

E. Direct Costs - Participant/Trainee Support Costs

	Funds Requested ($)
1. Tuition/Fees/Health Insurance	**0.00**
2. Stipends	**0.00**
3. Travel	**0.00**
4. Subsistence	**0.00**
Number of Participants/Trainees: **Total Participant/Trainee Support Costs**	**0.00**

PI Name : **Tara Firenzi**	**NASA Proposal Number**
Organization Name : **PACIFIC COLLEGIATE SCHOOL**	**09-EPOESS09-0032**
Proposal Title : **A Big History of the Universe for Secondary Education**	

SECTION X - Budget

Start Date :	End Date :	Budget Type : **Project**	Budget Period : **4**

F. Other Direct Costs

	Funds Requested ($)
1. Materials and Supplies	0.00
2. Publication Costs	0.00
3. Consultant Services	0.00
4. ADP/Computer Services	0.00
5. Subawards/Consortium/Contractual Costs	0.00
6. Equipment or Facility Rental/User Fees	0.00
7. Alterations and Renovations	0.00
Total Other Direct Costs	0.00

G. Total Direct Costs

	Funds Requested ($)
Total Direct Costs (A+B+C+D+E+F)	0.00

H. Indirect Costs

	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
	0.00	0.00	0.00
Cognizant Federal Agency:		**Total Indirect Costs**	0.00

I. Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Costs (G+H)	0.00

J. Fee

	Funds Requested ($)
Fee	0.00

K. Total Cost

	Funds Requested ($)
Total Cost with Fee (I+J)	0.00

“A Big History of the Universe for Secondary Education”

PI:	Tara Firenzi
Co-Is:	Joel Primack, Ph.D, Nancy Abrams, Darrell Steely, Joel Tarbox
Collaborators:	Doris B. Ash, Ph.D, David Christian, Ph.D

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Proposal Summary

This proposal is to develop secondary school level curricula including videos in the fields of cosmology, astrobiology and world history in order to harness the very latest developments in these closely connected fields to expand the thinking of young students as early as possible. This project fulfills NASA's goal of sharing "the story, the science, and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe."

Over the past decade, world historians and social science educators have come to realize that the origin of our universe is the beginning of our human story. Though the incorporation of these ideas into secondary curricula is not yet widespread, well respected efforts such as "World History for Us All," a project of the National Center for History in Schools at UCLA, have strongly advocated for the incorporation of the history of the universe in world history curricula. Books like David Christian's *Maps of Time: An Introduction to Big History* (2005), suggest that these efforts should and will become a more significant part of both history and science instruction in secondary schools in the near future, making instruction in both areas more interdisciplinary and thus more effective.

In scientific fields, of course, the importance of the origins of the universe has long been understood. Bringing us to a new level of understanding on the subject of these origins, University of California, Santa Cruz Professor Joel Primack and UCSC lecturer Nancy Abrams have recently introduced a number of new ideas about the connections between advanced scientific theories and the historical importance of the origins of the universe as discussed in their book, *The View From the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos* (2006). The authors incorporated a significant amount of ground-breaking cosmological research done by co-author Joel Primack and other cosmologists, and this research represents some of the most important work being done in astrophysics today. Abrams and Primack also tied in fundamental discoveries in other aspects of astronomy, evolutionary biology, geology, planetary science, geology, and archaeology.

This proposal brings together the cutting-edge scientific theories and research discussed in *The View from the Center of the Universe* and the themes of "Big History" that are becoming increasingly important in world history education at the secondary level. Specifically, three half-hour videos would be produced for classroom use at the secondary level, in various science and world history classrooms. These videos would incorporate visual data from simulations conducted by Joel Primack and other cosmologists in order to provide junior high and high school students with access to some of the most up-to-date and exciting visual information available about the universe. In addition to these videos, ancillary standards-based curricular materials would also be developed by a team of teachers from Pacific Collegiate School—a school recognized by all available measures as one of the nation's best public, college-preparatory high schools—along with the help of UCSC Education faculty and graduate student researchers.

Introduction

To help fulfill NASA's goal of sharing "the story, the science, and the adventure of NASA's scientific explorations of our home planet, the solar system, and the universe," the work of this proposal centers on the creation of secondary level curricular materials that harness the very latest developments in the field of cosmology and astrobiology. Bringing these developments to secondary level students through engaging curricula will not only educate, engage and inspire them, but will also teach them more about their own personal connection to the greatest events in the history of the universe, and about their place in the universe as it is today.

The universe beyond earth is often portrayed as cold and distant. We call it "outer space" or "the void of space," as if it's a bleak and distant place that we're not a part of. Ironically, modern science has brought the universe closer than ever to us—we can now watch the universe in crystal-clear, high definition images. And yet, in personal terms, the universe is farther away from most people than it's ever been. Three thousand years ago, when Egyptians looked up to the heavens, they saw a cosmic drama that included them *personally*. Ancient humans knew that they were connected to the earth, the sun, and the universe beyond…they just didn't know how this connection worked scientifically. Today, when most people stare at the heavens, what they see is a chilly emptiness, a grim reminder of how alone and isolated humans are in the void of space. Today, most people imagine the earth as a contained sphere of human activity, and the universe beyond as a separate domain. This feeling of disconnection is uniquely modern, and though in some ways it is a disconnection that has been fostered by modern science, it is scientifically inaccurate.

Recently, steps have been taken by those in the field of astrophysics and the field of history to bridge this divide between our world and the universe which lies beyond, and because of these efforts, we now have the ability to make the universe and our planet friendlier and more familiar entities. For instance, proponents of "Big History" have taken the human story all the way back to the Big Bang, seamlessly weaving together the history of the universe with human history, long seen as discrete and separate modes of thinking about time and space. The historians who are developing this area of world history have made a strong case that our history does not start with writing, nor even with the development of modern humans, but rather with the origin of the universe. In what is widely acknowledged to be the most elegant work of "Big History" yet attempted, David Christian (a collaborator on this proposal) has argued the validity of this interdisciplinary approach to history in *Maps of Time: An Introduction to Big History*.[1] Another book, *Big History: From the Big Bang to the Present* by Cynthia Stokes Brown[2], has also recently created a stir among historians who have thought on a much smaller scale for many years. And, though these ideas are quite new, already a number of secondary level world history textbooks at least allude to the evolution of the universe and our planet as part of their overall narrative. As world historians continue to draw conclusions based on large-scale patterns across time and space, this component of our human history will become more and more integrated into the way we can view ourselves. Accordingly, the aim of this proposal is to bring this new way

[1] David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press 2004).
[2] Cynthia Stokes Brown, *Big History: From the Big Bang to the Present* (New York: New Press 2007).

of viewing ourselves to all levels of secondary students by creating appropriate and engaging interdisciplinary curricular materials for students of science and history in particular.

This proposal is also inspired in large part by the work of Primack and Abrams in *The View from the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos* (2006).[3] A short summary of the book, written by co-author Nancy Abrams, follows here:

"The world today is undergoing a cosmological revolution as momentous as the Copernican revolution. In the last ten years modern scientific cosmology has discovered that all the stars, dust, gas, even distant galaxies - are only half of one percent of what is actually out there. The cosmic density is mostly dark matter and dark energy, which shape the galaxies and cause space to expand faster and faster. Astronomy for the first time has a foundational theory and massive amounts of data supporting it. Without using mathematics (except for the powers of ten), *The View from the Center of the Universe* by Primack and Abrams (2006) presents this new understanding of how the universe as a whole evolved and operates – an understanding Primack helped create. Primack and Abrams introduce several symbols that let the reader grasp the fundamental characteristics of the universe all at once, rather than having to hold in mind a long chain of explanation. These symbols are based on redefined ancient symbols and metaphors, which helps communicate the depth of the subject matter. The book summarizes the 5000 year history of changing cosmologies from Sumer and ancient Egypt to the Newtonian picture, showing the connections between cosmology and culture, and suggesting that modern culture too will inevitably change when the new picture of the universe is absorbed. Subsequent chapters each lay out a key scientific principle, for example that humans and Planet Earth are made of the rarest material in the universe – heavy atoms cooked up in stars and spewed out at the ends of their lives. This rare stardust is concentrated here on Earth. It appears ordinary to us, but stardust represents only $1/100^{th}$ of one percent of what the universe as a whole is made of. Another chapter is about the importance of size, since the laws of physics that control events are different on different size scales. This chapter also demonstrates that humans are in the middle of all possible size scales. The last two chapters discuss the possible implications for today's culture of these and other new cosmological ideas and suggest that a new picture of the universe could provide an underpinning for a globally shared picture of reality, which could improve prospects for global cooperation in the longer term."

[3] Joel Primack and Nancy Abrams, *The View from the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos* (New York: Riverhead Books 2006).

Objectives:

Specifically, the key, central objectives of this proposal include the following:

- To develop three, one-half hour long videos and accompanying curricular materials that are developmentally appropriate for all levels of students in grades 7-12. The first would focus on cosmology, the second on astrobiology, and the third on world history;
- To create a multi-layered companion website accessible to teachers and students (much like the Stromatolite Explorer website[4] already hosted by NASA);
- To engage students of all levels in high-level scientific and historical thinking;
- To bring cutting-edge cosmological and technological innovations and discoveries into the classroom, especially in schools where students might have limited exposure and access to these kinds of developments;
- To develop stand-alone, standards-based curricular units that are meaningful, relevant, and engaging for all students;
- To tap into different learning styles by using audiovisual materials, hands-on lab activities, and math-based approaches to understanding the universe;
- To bring together world history, physics, biology, environmental science, astronomy, and mathematics to demonstrate the interdisciplinary relevance of recent cosmological discoveries;
- To provide professional development resources that allow teachers to help students fully understand the concepts and meanings of new developments in cosmology, both in scientific and historical contexts; and
- To inspire students to pursue top level research of the type that university researchers are performing.

The three videos that the team would produce would focus on three separate but linked topics in order to allow teachers of certain subjects to be more specific in the way they used the curriculum. The short length of the videos has been very deliberately chosen so that teachers can introduce students to high-level, ground-breaking new ideas in an engaging and meaningful fashion without pushing aside too much of their existing curriculum. Teachers will no doubt be more inclined to incorporate the videos into their curriculum because of their short length, especially if they receive training and professional development specifically targeted towards using these materials both effectively and concisely.

The first video will focus on cosmology. It will be designed primarily for secondary level physical science, theoretical physics and earth science courses, and will include visualizations of recent simulations performed by top scientists in the field of astrophysics along with the implications of these simulations. Essentially, our view of the universe over the last ten years has changed radically because of new discoveries, and new ways of conceptualizing the makeup of the universe.[5] These methods and ideas belong to the ΛCDM "Double Dark Theory," a means of explaining the evolution and composition of the universe. Breakthroughs which occurred as

[4] Brad Bebout, curator, "Microbes at NASA," 15 Feb 2007, NASA Ames Research Center, 29 June 2009, <http://microbes.arc.nasa.gov/>.

[5] Please see the references section for a number of different recent works that contribute to our knowledge base on this particular topic.

part of the development of this theory ten years ago allowed astrophysicists to assemble a new picture of the universe, and all the data that has been collected over the last ten years support this new theory; in fact, it has now become the Standard Cosmological Model. These concepts easily correspond with the state science standards in many states around the country. The state of California, for example, requires that its 8th graders enrolled in Physical Science study the structure and composition of the universe, including stars and galaxies and their evolution (Standard 4). California also requires that its students take Earth Science at some point during their 9-12 grade years, and as part of these standards, students are to learn about how "astronomy and planetary exploration reveal the solar system's structure, scale, and change over time" (Standard 1) as well as how "earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time" (Standard 2). Standard 2 is aligned even more clearly with the objectives of the present proposal in its detailed sub-standards. According to the state, all students should be given the opportunity to learn that "accelerators boost subatomic particles to energy levels that simulate conditions in the stars and in the early history of the universe before stars formed" (Standard 2e), that "the evidence indicating that the color, brightness, and evolution of a star are determined by a balance between gravitational collapse and nuclear fusion" (Standard 2f), and that "the red-shift from distant galaxies and the cosmic background radiation provide evidence for the "big bang" model that suggests that the universe has been expanding for 10 to 20 billion years" (Standard 2g). All of these various standards would be clearly addressed by the curriculum that the team would be assembling, and the material would be relevant to similar standards in other states besides California. Beyond the standard courses offered in most schools, AP courses (where they are offered) provide another venue for the inclusion of this curriculum. Finally, since the defined curriculum for AP classes ends with the administration of the AP exam, there are usually several weeks to fill with the kinds of thought-provoking and interdisciplinary concepts that the proposed curriculum would offer. Many AP Environmental Science and AP Physics teachers are constantly on the lookout for stimulating and engaging material to use in their classrooms for the remainder of the school year, especially since they are basically operating at that point with complete curricular freedom.

The second video will focus primarily on astrobiology, including the biological ramifications of these new discoveries in cosmology, the potential for life on other planets, the rarity of the type of cosmic materials that can create life forms, and the conditions required for a planet to be habitable.[6] According to the California State Standards, in 7th grade life science, students learn about "Earth and Life History," and specifically about how life on earth is connected to the universe beyond it. For instance, according to Standard 7.4b, students are expected to know that "the history of life on Earth has been disrupted by major catastrophic events, such as major volcanic eruptions or the impacts of asteroids." Standard 7.4d also says that they are also expected to know "that evidence from geologic layers and radioactive dating indicates Earth is approximately 4.6 billion years old and that life on this planet has existed for more than 3 billion years," and the videos the team seeks to produce would help contextualize the evolution and development of life on earth as a part of the evolution of the universe. As noted above in the discussion of science standards for 9th through 12th grade, California does not specify when exactly students take certain science courses, but they are required to take a more advanced life

[6] Reference materials that the team would be using include the two books about astrobiology (one authored by Jonathon Lumine and the other by Kevin Plaxco and Michael Gross) cited in the references section of this proposal, as well as the biology textbooks included in the references (both by Neil Campbell).

science course at some point in their high school career. The standards for this course that could be supported by use of the curriculum that the team would develop include the standards around cell biology (Standard 1), ecology (Standard 6), and evolution (Standard 7 and 8). The Advanced Placement (AP) Biology course would benefit from this proposed curriculum. Two major themes of the AP Biology course, as described by The College Board, are "Science as a Process" and "Science, Technology, and Society." These themes are essential components to our current understanding of the universe and astrobiology, and why it is important for us to understand the universe. Additionally, the AP Biology curriculum specifically requires that students understand the essential ingredients for life and the possible mechanisms for the early evolution of life. AP Biology also provides opportunities to include the proposed curriculum, particularly as it focuses on evolution, molecular biology, diversity of organisms, and ecology. Alternatively, the weeks after the AP Biology test is administered would be a great place to include this curriculum, as mentioned above.

The third installment would focus on the place of cosmology in world history, and how the new cosmological ideas developed by Abrams and Primack can better help us to understand both the past and the present. This video would highlight different developments in the history of science that have led us to where we are today in our understanding of the universe, the nature of different cosmological worldviews throughout history, and how the intellectual adventure of cosmology is unique and truly exciting. For the first time, we have today a detailed picture of the history and composition of the universe, based on and supported by a wealth of scientific evidence. Though "Big History" is too new to have traveled into the social science standards directly, there are many places in which teachers could use these videos and curriculum to expand on the standards that exist. For instance, in California, 7th grade teachers of Medieval World History should "Detail advances made in literature, the arts, science, mathematics, cartography, engineering, and the understanding of human anatomy and astronomy" during the Renaissance, according to Standard 7.8.5, and they should "analyze the historical developments of the Scientific Revolution and its lasting effect on religious, political, and cultural institutions**,"** according to Standard 7.10. In explaining the cosmological frameworks that existed before, during and after these two intellectual movements as this video would do, students would not only better understand the significance of the scientific developments that occurred during the Renaissance and the Scientific Revolution, but they would understand why those developments are relevant today, a major goal of all history teachers as they attempt to connect the past with the present. The 10th grade social science standards in California also require teachers to explain how scientific discoveries contributed to the changing world in modernity; for example, standard 10.3.2 mandates that students "Examine how scientific and technological changes and new forms of energy brought about massive social, economic, and cultural change" to 19th century Europe, and the final standard, 10.11, says that students will "analyze the integration of countries into the world economy and the information, technological, and communications revolutions (e.g., television, satellites, computers)." Since our new understanding of the universe could certainly be described as a "technological revolution," this standard would be another place in which to situate the curriculum that the team wishes to develop.

Finally, in the AP World History course, one of the fastest growing courses in the College Board's retinue of AP offerings, this type of big picture, comparative view would be particularly useful to teachers and students. By connecting scientific views of the past with the scientific

views of the present, teachers will be addressing five of the central "habits of mind" developed as part of the AP World History curriculum:

- Seeing global patterns and processes over time and space while connecting local developments to global ones
- Comparing within and among societies, including comparing societies' reactions to global processes
- Considering human commonalities and differences
- Exploring claims of universal standards in relation to culturally diverse ideas
- Exploring the persistent relevance of world history to contemporary developments.

Throughout the AP World History curriculum, mythology, scientific developments, and technological advances are repeatedly emphasized, and there would be numerous places for teachers to use this type of curriculum. Also, as is also the case with AP Biology, AP World History teachers frequently have very little in the way of specific content delivery that they need to accomplish after the AP test. The materials that the team proposes to create constitute an important and relevant curricula that could easily be used to generate discussions and projects about related topics—such as "Big History" and its historiographical merits and legitimacy—that teachers may not be able to explore quite as fully during the "AP year" due to the vast amount of material that needs to be covered, and would consider to be very appealing teaching units once the AP test has been administered.

As discussed more fully below, each of these videos would be tested on culturally and linguistically diverse student populations, and the materials (and perhaps even the content of the videos themselves) would be differentiated in order to reach the full spectrum of students.

Methods and Techniques Proposed:

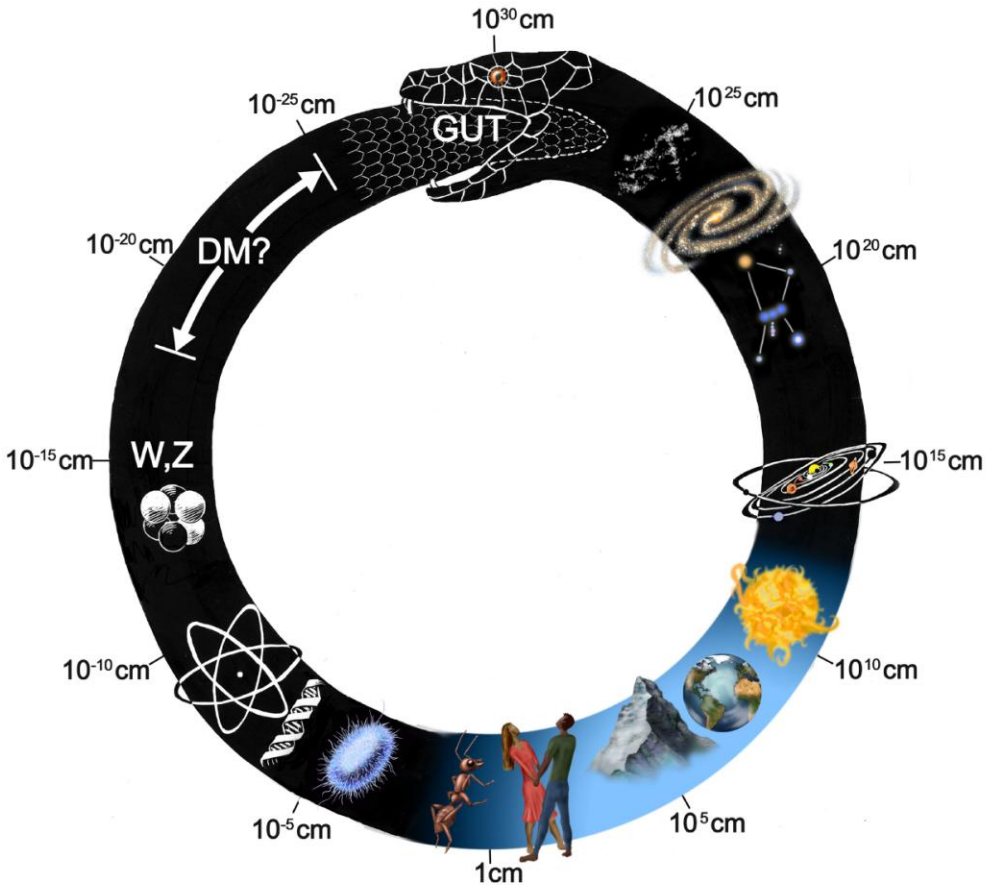
Using both the students at Pacific Collegiate School and students from other local schools with different demographic compositions, the team would develop and test materials based on the work done by Professor Joel Primack, Nancy Abrams and Professor Primack's colleagues in astrophysics. The team would also look closely at the work of other similar projects, including the "Microbes at NASA" (Stromatolite Explorer) website[7] and the SETI "Voyages Through Time"[8] curricula as models. The scripts would be largely developed by Tara Firenzi (PI), Professor Primack (Co-I), Ms. Abrams (Co-I), Darrell Steely (Co-I), and Zoe Buck (Graduate Student Researcher), bringing together a powerful combination of educators and scientists. Visual simulations generated by the NASA supercomputers that represent the most innovative work available on the structure of the universe and the visualization of dark matter would figure prominently into the videos. These videos would be aided by some of the graphics used by Abrams and Primack to clearly and engagingly explain complex cosmological concepts in *The View from the Center of the Universe*. The illustrations in this book have received much acclaim, and could easily provide students at the secondary level with the tools to more effectively understand the nature of the universe.

One of these images, the cosmic urboros, is one of the many innovative illustrations that Ms. Abrams and Professor Primack use in their book to demonstrate our central place in the universe. Abrams and Primack have adapted this image from both an ancient symbol and from an idea developed by the Nobel Prize winner Sheldon Glashow, and they use it to show the spectrum representing size scales from the very smallest to the very largest. As can be seen below, the image compellingly demonstrates that humans occupy the center of this range. The smallest size (the Planck length) is 10^{-33} cm, and the visible universe itself is 10^{29} cm. At approximately 1-2 meters, or 10^{2} cm, humans are almost at the exact midpoint of these two extremes. It is at their middle range of size scales that the greatest complexity can develop—such as the human brain. It is this type of compelling imagery and visualization of a complicated concept that will help students at the secondary level better understand how new developments in astrophysics have given us a new understanding of our place in the universe.

The cosmic uroboros is also a useful image with respect to this proposal because the concept of the uroboros comes from the ancient world, and has been used for millennia to represent different ways of thinking about the universe. With respect to the link between the new cosmological views put forth by Abrams and Primack and their connection to different cosmological views throughout history, this particular image clearly demonstrates that scientific developments today can be to us what early interpretations of the cosmos were to ancient Greeks, for instance.

[7] Brad Bebout, curator, "Microbes at NASA," 15 Feb 2007, NASA Ames Research Center, 29 June 2009, <http://microbes.arc.nasa.gov/>.

[8] "SETI Voyages Through Time Curriculum," 2008, SETI Institute, 29 June 2009, <http://www.seti.org/Page.aspx?pid=345>.



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The three proposed videos would be produced primarily by Co-I Joel Tarbox, a respected graphic designer, painter, and teacher of video productions at Pacific Collegiate School. Though the project would be overseen at every level by Mr. Tarbox, students would be involved in the creation and planning of the video so as to increase its appeal to students in secondary education. To have students working on the project at the ground level is an opportunity that we should embrace, as students are much more likely to engage with material that their peers find interesting and valuable than what well-meaning adults often develop; educational research has proven this time and again. Because Pacific Collegiate School is a charter school with high enough test scores to allow teachers flexibility in designing a meaningful curriculum, not only would students be able to help with the development and production of the videos, but students in theoretical physics classes, AP Biology and AP World History courses, and ancient world history courses would be able to test them out and give feedback that would help to improve the materials. In fact, this last course—ancient world history—offers a unique opportunity to try out the videos in a historical context, since the course takes the cutting-edge, "big history" approach that many world historians would like all schools to move more towards. Pacific Collegiate

[9] From *The View from the Center of the Universe* website: "The View from the Center of the Universe," 2006, Abrams and Primack Inc., 28 June 2009, <http://viewfromthecenter.com/files/images/uroboros-color.jpg>.

School is in a very strong position to develop this curriculum as it has the flexibility to incorporate it into the curriculum even in its most incipient forms. In these early stages, the team would employ best practices in assessing effective student learning to measure the degree to which the materials are engaging and resonant with secondary level students. Finally, Solana Pyne (Consultant), a graduate of the UCSC program in science journalism and a former associate producer for NOVA, would provide consultation services to ensure that the best practices of professional documentarians were observed throughout the process.

The accompanying curricular materials would be developed primarily by Darrell Steely and graduate student researcher Zoe Buck. These materials would include computer-based labs that incorporate some of the technology demonstrated in the video, and other labs that would specifically focus on secondary level physics, biology and mathematics standards adopted by numerous states. They would also include discussion questions, plans for student projects, and worksheets that teachers could use as companions to the video, and provide lists of internet resources that could be used for further development of these topics. Teachers would also be provided with assessments that were linked to state standards so that they could measure the impact of the curriculum on overall student learning, and rubrics to help them better assess how much their students had learned. Finally, the team would develop a companion website that would house further materials for students and resources for professional development that Joel Tarbox would design and manage.

The UCSC Department of Education has already been consulted on the best way to develop these materials as well, and has volunteered their assistance in testing the materials in various settings so as to ensure that the material is accessible and interesting for students of all levels. Part of the budget for this proposal includes stipends for teachers in lower-income districts nearby to the university in order to compensate teachers for their involvement in field testing the materials. In particular, Mr. Steely, Ms. Firenzi and Ms. Buck would be developing curricula with English language learner populations in mind, making sure to include resources for teachers that will help them engage students who struggle with the English language. The team would construct assessments which, once administered to test populations of students, would produce data showing what changes needed to be made to the curriculum. These assessments would be especially helpful in allowing the team to determine whether or not the materials were reaching diverse populations of students. To help with this side of the project, Collaborator Doris Ash would bring her expertise as a faculty member of the UCSC Department of Education, and she would also be supervising and guiding the work done by Ms. Buck in her role as Ms. Buck's advisor.

In addition to the expertise of the team members, we also plan to create an advisory board that can help advise the team on recent scientific research, best practices in science education, and effective curriculum design for secondary age students using audiovisual materials.

With respect to the distribution of materials, we would be focusing primarily on making the videos and curriculum available through our companion website (as NASA has done very successfully with the Stromatolite Explorer website, for instance), but we would also be producing 1,000 hard copy DVDs and accompanying hard copy materials for distribution to teachers that would prefer to not use a web interface. Producing DVDs would also allow for us

to provide higher quality images to teachers. Once the DVDs were produced, we would sell them at a very low cost (under $10, including shipping) through filmbaby.com and curricular catalog services that target secondary education teachers (the Social Science School Service catalog, which is known as the primary source for social science curricular materials, is an example of this kind of distribution resource). Finally, PI Tara Firenzi and Co-I Darrell Steely would both attend conferences in their respective fields during the third year of the project to promote the curriculum among their peers. Ms. Firenzi would attend the World History Association Conference, which targets both university and secondary level educators in the field of world history, and Mr. Steely would most likely present the materials at the National Science Teacher's Association conference, the California Science Teachers Association (CSTA) Conference, or the National Association of Biology Teachers (NABT) Conference. Tara Firenzi will also present the materials at the California Charter School Association Conference as part of a subject specific seminar, as charter schools have more flexibility and room for innovation in their approach to teaching than traditional public schools do and therefore might find the curriculum particularly appealing. Pacific Collegiate School is well known among this community and would be able to have an unusually high degree of influence on other schools attending the conference, having won the association's 2006 California Charter School of the Year award, and also having won recognition from the *U.S. News and World Report*'s annual rankings as the top charter school in the nation for the past two years in a row.

Additionally, in the third year of the project, the team would firstly seek a collaboration with the COSMOS program hosted through UCSC in order to promote the materials and use them among a target population of students who are very motivated in the field of science (Darrell Steely is a long-time teacher fellow in the program). Also, COSMOS makes significant efforts to diversify their student population, and so because students at COSMOS are from all possible backgrounds throughout California, these materials could be used with a wide range of students to measure efficacy early on. Secondly, that year, the team plans to host a conference for secondary education professionals who are interested in the curriculum, and this conference would be hosted through the new High Performance AstroComputing Center at UCSC. This center has just been funded through the University of California, with Professor Primack as its director. One of its central aims is outreach and education, and because of Professor Primack's connection to this proposal, we could use this new center as yet another way of bringing this project to more people. The center will also act as a "one-stop-shop" for the world's best "astromovies," a resource that would be invaluable to this project, as those are the types of visual data that form the basis for much of the curriculum. Finally, Professor Primack has also submitted a concurrent proposal to NASA for the Outreach component of the 2009 ROSES Opportunities in Education and Outreach solicitation; if funded, this other project would result in the creation of even more videos that could be employed in the creation of the materials we hope to create through this proposal.

Significance:

The significance of these educational materials would be tremendous, and would have a far-reaching impact on students of all levels. The inaccurate depictions of the universe that kids everywhere have long embraced through popular media like the *Star Wars* movies can now be replaced by images that *actually* exist—and in their fullest glory. The simulations made possible by the NASA supercomputers take viewers billions of light years into the past to the very outer edges of the universe, challenging our imaginations. The images are hypnotizing, powerful, and highly educational—most students have no idea what the universe looks like, nor the ramifications of this new level of understanding. In fact, some students who live deep in America's largest cities barely know what stars look like because of the ambient light that hides the beauty of the night sky. Seeing these simulations would truly open up entirely new ways of thinking about the universe and science in general for them, and could easily inspire them to pursue careers in STEM fields later on in their lives. Developmentally, it could also capture young minds at a moment when they are still open to thinking about the universe in new ways; as we grow older, it becomes more and more difficult to think in new ways, and we tend to lose some of our imaginative capacity and thus our ability to be inspired in the way that young people can. Finally, to discover that such knowledge of the universe is possible is inspirational in and of itself, but to explain why this research is meaningful holds even more exciting possibilities for student engagement and interest in the sciences.

An article appeared in the July 2009 issue of National Geographic about the powerful telescopes that bring us the sort of images we would be using in these videos. The article begins with the following statement:

> When you start stargazing with a telescope, two experiences typically ensue. First, you are astonished by the view—Saturn's golden rings, star clusters glittering like jewelry on black velvet, galaxies aglow with gentle starlight older than the human species—and by the realization that we and our world are part of this gigantic system. Second, you soon want a bigger telescope.[10]

Bolstering the claim that firstly, we can feel a much stronger connection to the universe by experiencing the images and visualizations made possible through NASA's supercomputers, this quote further demonstrates the addictive quality of this process of astronomical discovery. By bringing the images of a much, much "bigger telescope" to students through this curriculum, there is certainly a strong chance that these students might also follow the typical pattern that this author describes; they might want to continue exploring in this field by pursing careers in science which allow them to seek bigger and bigger windows on the universe later on in their lives.

Another pertinent example of the relevance of this project lies in the recent discovery of the SN2008ha junior supernova, an astronomical peculiarity that has many astronomers puzzling over why it defies easy categorization as either a nova or a supernova. The reason that this discovery is especially relevant to this proposal is the simple fact that the SN2008ha was first

[10] Timothy Ferris, "Cosmic Vision: A New Generation of Giant Telescopes Will Carry the Eye to the Edge of the Universe," *National Geographic*, 216.1, July 2009: 122.

observed by a fourteen year old in New York, the youngest person to ever discover a supernova of any kind. The young woman, Caroline Moore, was recently interviewed on the Rachel Maddow Show, and attributed her fascination with the sky to the data and images made available by the Hubble Telescope. And so, perhaps even more significantly than the discovery itself, her discovery proves without a doubt that the images and ideas that the team proposes to use are capable of inspiring students at the secondary level to explore the universe, seeing it as a friendly and approachable entity rather than a distant and removed body that is completely disassociated with us here on earth. Alex Filippenko, the leader of the UC Berkeley supernova group said this about the discovery: "Coincidentally, the youngest person to ever discover a supernova found one of the most peculiar and interesting supernovae ever. This shows that no matter what your age, anyone can make a significant contribution to our understanding of the Universe."[11] By bringing images like the ones that inspired Ms. Moore to students across the country as well as an understanding of the importance of these images, how many more young people will be inspired to make new and important discoveries, and feel that much more connected to the universe around us?

Furthermore, as noted earlier, the ramifications of these simulations and their implications certainly transcend astronomy and astrophysics. They extend into many scientific fields, including astrobiology, and biology in general, helping us to answer the basic question, "what does it take for a planet to be habitable?," and the perennially interesting question, "if certain factors have allowed for intelligent life on this planet, do what are the chances that they could exists on other planets that might also sustain intelligence?" Furthermore, the chemical composition of galaxies plays a major role in the concept of galactic habitable zones, allowing students who enjoy chemistry to find value in these new ideas. Finally, grasping even the lowest level of the mathematics involved in these scientific endeavors can help students to understand the relevancy of math, and some of the more beautiful ideas that mathematicians work with, such as fractals.

Beyond the clear significance of these ideas in various scientific and mathematical fields, teachers and students of world history would also benefit hugely from these materials. The work of Joel Primack and Nancy Abrams aims to demonstrate not only the usefulness of cosmology today, but also how cosmologies have changed throughout time, and the different roles that they have played in civilizations. On a small scale, in using this perspective on cosmology to tell the human story, a world history teacher can communicate to students how social science can be intertwined with laboratory sciences, and how similar methodologies can be applied. However, on a bigger scale, getting students to think about *their place* in the universe has even more significance—to have a sense of why we matter, and how we can make a difference in our own future has tremendous potential to shape the views of young people in a profound and meaningful way. Even more than that, using big history as a framework for understanding ourselves can allow us to see the commonalities between us rather than all the many divisions that have existed among humankind throughout history. As David Christian said in his book, *Maps of Time*,

[11] "Supernova Discovered By New York Teen," 11 June 2009, *ScienceDaily*, 30 June 2009, <http://www.sciencedaily.com /releases/2009/06/090610154505.htm>

> In a world with nuclear weapons and ecological problems that cross all national borders, we desperately need to see humanity as a whole. Accounts of the past that focus primarily on the divisions between nations, religions, and cultures are beginning to look parochial and anachronistic—even dangerous. So, it is not true that history becomes vacuous at large scales. Familiar objects may vanish, but new and important objects and problems come into view.[12]

More and more, the world needs to understand that not only do we share a common history, but that we need to embrace that shared past in order to work together to preserve our planet and make the world habitable for many millions of years to come. This project aims to raise awareness of these issues, and will ably serve the goals of the EPEOSS mission.

General Plan of Work

Timeline for construction of videos and curricula:

Year 1:

- Start date: January 1, 2010
- By April, 2010: Preliminary scripts completed for all three videos
- By May, 2010: Storyboards constructed for all three videos, incorporating visual materials and simulations
- By December, 2010: Preliminary filming finished

Year 2:

- By February, 2010: Preliminary editing finished
- By June, 2011: Field tests conducted at three sites: Pacific Collegiate School, which targets a college-bound population of highly motivated students in grades 7-12; a school with a significant Latino population, such as Watsonville High School; and one other nearby school with a more varied population of students, such as Santa Cruz High School
- By August, 2011: Areas that need editing/adjustment based on field tests are identified, and plans are set to fix these issues
- By November, 2011: Final edits finished

[12] David Christian, *Maps of Time: An Introduction to Big History* (Berkeley: University of California Press 2004) 8.

Year 3:

- By April, 2012: Development of curricular materials finished
- By September, 2012: Companion website up and running
- By September, 2012: Outreach via presentations at conferences
- By September, 2012: Conference held to train high school teachers on the use of these materials
- By December, 2012: Active distribution of materials to secondary schools across the nation

The management structure would be as follows:

The PI, Tara Firenzi, would make sure that all necessary work was being completed in a timely fashion, and would manage the progress of the project to ensure both quality and productivity. She would be responsible for monitoring the budget and for communicating with the funding agency. She would also be involved at all levels of the development of the videos and their accompanying curriculum, and would assume primary responsibility for developing content pertinent to the historical contextualization of this material.

Co-I Joel Primack would provide the scientific expertise required for the development of the videos, and would provide the simulations for the videos as well. Co-I Nancy Abrams would provide guidance on the scripts and storyboards, and identify ways to incorporate elements of the book that she and Professor Primack wrote about the place of humankind in the universe. Co-I Darrell Steely would work primarily on the writing of scripts, the creation of ancillary curricular materials, the creation of professional development materials, and the content of the website. Co-I Joel Tarbox would work primarily on the production and editing of the films, and would manage all student participation in their creation as well. He would also be responsible for the design and upkeep of the companion website, and the design of the ancillary curricular materials.

Collaborator Doris Ash would provide guidance and supervision to GSR Zoe Buck as she develops materials and assessment tools for the project, and would advise the team on best practices in the development of educational materials for secondary students of all backgrounds. Collaborator David Christian would provide guidance as the project progresses, specifically with respect to the world history component of the curriculum;

GSR Zoe Buck would provide research assistance on the scripts, help with the writing of the scripts, and would play a major role in field testing the materials; and

Consultant Solana Pyne would provide feedback and guidance about the presentation of the material in the videos.

Selected References

Books:

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Hadingham, Evan. *Early Man and the Cosmos.* New York : Walker and Co., 1984.

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Lemonick, Michael D. *The Light at the Edge of the Universe: Leading Cosmologists on the Brink of a Scientific Revolution.* New York: Villard Books, 1993.

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Articles:

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The Elegant Universe. By Julia Cort, Joseph McMaster, and Brian Greene. DVD. Nova Productions, 2000.

Origins: The History of the Universe. By Thomas Levenson, Larry Klein, Julia Cort, and Neil deGrasse. DVD. Nova Productions, 2005.

Websites:

"AP Central." 2009. The College Board. 29 June 2009. <http://apcentral.collegeboard.com/apc/public/courses/index.html>

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Biographical Sketch for Tara Firenzi, Principal Investigator

EDUCATION:

M.A. from Stanford University in History (Africa focus). Primary area of study within field: Changing Political, Social and Religious Functions of Dance Practices in 19th and 20th century Zulu Society. Additional major research focus: Life and work of George Seldes (American journalist); spent summer of 2007 researching the George Seldes Collection at the University of Pennsylvania. 4.0 GPA; 6/07.

Single Subject Teaching Credential (CLAD) with authorizations in Social Science, English and Physical Education from San Jose State University. Took courses on methods, assessment, literacy and ESL training. 3.96 GPA; 5/06.

B.A. from the University of California, at Los Angeles. Graduated in three years. College Honors, Latin Honors (Cum Laude), Provost's Honors. History major (3.73 GPA in major subject) with a focus on modern European social and political history. English Literature minor, Italian and Spanish languages.
3.63 GPA; 6/01.

EXPERIENCE:

World History Teacher and Faculty Dean
Pacific Collegiate School, Santa Cruz, CA

As Faculty Dean, serve as one of four members on the school's management team, coordinate professional development opportunities, observe and evaluate 1/3 of the school's teachers, set up evaluation system, interface with the board on issues related to teacher performance and evaluation, run leadership team meetings, develop a hiring plan, and participate in the hiring of new faculty.

Teacher of advanced level 8th (Ancient World History), 9th (World History 500-1750) and 10th (AP World History) grade world history courses at the top charter school in the nation (2007 and 2008 *US News and World Report* rankings). Develop lesson plans and lectures, coordinate curricula for various ability levels, and work with colleagues to align world history curriculum vertically with AP World History Exam. Served as History Department Chair from 2005 to 2008. Sole teacher and creator of the AP World History program between 2004 and 2006**—this course was named the "Best AP World History Program in the Nation" for the 2005-2006 school year**. Gave a presentation at the AP National Conference in Seattle during the summer of 2008 about the three year world history program at Pacific Collegiate School. Additionally, teacher of "Dance Studies," supervisor of the school dance company, and choreographer of school musicals.

Served as Faculty Representative to the Pacific Collegiate School Board (an elected position) during the 2007-2008 school year. Monitored, assessed and reported on faculty opinion with respect to all issues discussed by the board, voted on all major

policy and personnel decisions at the board level, and pushed through a proposal to give teachers a 3.6% COLA for the 2008-2009 school year.
8/03 to present

SAT Teacher
Princeton Review, Palo Alto, CA and New York, NY.

Taught SAT (verbal and quantitative) and SAT II (Writing, Math IC and Math IIC) preparation courses for all ranges of students in Palo Alto, San Jose, Santa Cruz, Manhattan, Queens, and the Bronx. **Won formal national recognition for highly effective teaching in 2003.**
8/00 to 8/03

Account Coordinator
Pedone & Partners, New York, NY

Coordinated the placement, production, and distribution of advertisements for an upscale international restaurant. Maintained all account paperwork and status reports, and corresponded with client and publications.
10/02-4/03

English Teacher
Petersen Middle School, Sunnyvale, CA

Developed lesson plans, coordinated curriculum for various levels of ability, assumed responsibility for grades, effectively communicated with parents and school administrators. Supervised after-school activities, including a dance and the homework club, as well as the graduation ceremonies.
4/02-6/02

Joel R. Primack

Distinguished Professor of Physics, University of California, Santa Cruz
Office Phone: (831) 459-2580, Fax: (831) 459-3043, Email: joel@scipp.ucsc.edu;
Home phone: (831) 425-1194; Cell phone: (831) 345-8960

Education
Princeton University A.B. 1966 Physics (Summa cum Laude)
Stanford University PhD 1970 Physics

Academic Positions
Junior Fellow, Society of Fellows, Harvard University 1970-73
Assistant Professor of Physics, UCSC 1973-1977; Associate Professor of Physics, UCSC, 1977-1983; Professor of Physics, UCSC 1983-present; Distinguished Professor 2007-
Director, University of California systemwide Institute on AstroComputation, 2010-

Advice (partial list): SAGENAP advisory panel to DOE/NSF 2000-2001; NSF Astronomy Theory Review Panel 2000; DOE Lehman Review of SNAP Proposal 2001; Chair, NASA Cosmology panel on LTSA and ADP 2001; Cosmology Panel, Hubble Space Telescope Time Allocation Committee 2003; Editorial Board, Journal of Cosmology and Astroparticle Physics 2003-06; National Academy Beyond Einstein panel, 2006-07.

American Physical Society activities (partial list): Executive Committee, APS Division of Astrophysics, 2000-2002; APS Panel on Public Affairs (POPA) 2002-2004; Chair, POPA Task Force on NASA Moon-Mars Program and Funding for Astrophysics 2004; Chair, APS Forum on Physics and Society 2005

Outreach (partial list): Smithsonian National Air and Space Museum, Advisory Committee on *Cosmic Voyage* IMAX film, 1994-1996. Co-organizer, "Cosmic Questions" Conference, Smithsonian National Museum of Natural History, Washington, DC, April 14-16, 1999. Co-author of popular book *The View from the Center of the Universe* (2006). Over 100 public lectures on cosmology, including Sackler Lecture (UC Berkeley, 2006), J. Robert Oppenheimer Memorial Lecture (Los Alamos, 2007), APS Public Lecture (St. Louis, 2008).

Honors (partial list):
A. P. Sloan Foundation Research Fellowship, 1974-1978
American Physical Society Forum on Physics and Society Award, 1977; Fellow, 1988
American Association for the Advancement of Science, Fellow, 1995
Humboldt Senior Award of the Alexander von Humboldt Foundation, 1999-2004

Books
Joel R. Primack and Frank von Hippel, *Advice and Dissent: Scientists in the Political Arena* (New York: Basic Books, 1974; New American Library, 1976)

S. Bonometto, J. R. Primack, A. Provenzale, eds., *Dark Matter in the Universe* (Amsterdam: IOS Press, 1996)

Joel R. Primack and Nancy Ellen Abrams, *The View from the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos* (New York: Riverhead/Penguin, 2006; London: HarperCollins, 2006; Paris: Laffont, 2008; and other foreign editions

Nancy Ellen Abrams, J.D.
575 High Street, Santa Cruz, CA 95060
Phone: 831-425-1194 • Fax: 831-425-1791 • Cell: 831-234-3958
Email: nancysview@gmail.com, Website: http://viewfromthecenter.com

I am the co-author (with cosmologist Joel R. Primack) of *The View from the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos* (Riverhead/Penguin 2006). Joel and I will be giving the Terry Lectures at Yale in October 2009 on the implications of modern cosmology, and this will result in a book to be published by Yale University Press. I have written numerous articles on science policy, space policy, and the possible cultural implications of modern cosmology. Recent ones are posted on Joel's and my joint website, http://physics.ucsc.edu/cosmo/primackabrams.html.

I have been involved in education since I helped develop and teach the first Women and the Law course at the Univ. of Michigan while still a law student in 1972. I have taught at the Univ. of California, Santa Cruz, a course called "Science and Technology in a Democracy," which I designed, and also "Cosmology and Culture," which Joel Primack and I co-designed and have taught for 11 years, and which has received awards from both the Templeton Foundation and the American Council of Learned Societies. In the fall of 2007 we were invited to teach cosmology to at-risk inner city high school students in Oakland, California, by Matthew Fox, the founder of a highly innovative program called "Youth and Elder Learning Laboratory for Ancestral Wisdom Education" (see http://yellawe.org/YELLAWE/Welcome.html). As a guest speaker, I have also taught cosmology to elementary students at Popper-Kaiser School and the Montessori School and to high school students at Pacific Collegiate School, all in Santa Cruz, and have lectured in 2000 and 2001 to the North American Montessori Teachers Association about the meaning of a "cosmic education." In our attempt to bring the modern universe to the public, Joel Primack and I have spoken at over a hundred venues, including the State of the World Forum in New York, the Senate Chamber of France, many conferences, universities including Berkeley, Columbia, Harvard, Princeton, Oxford and Cambridge, and also Google and the U.S. Treasury. A complete list of appearances since 2006 is at http://physics.ucsc.edu/~joel/Author_Appearances.htm

I have a B.A. in the history and philosophy of science from the University of Chicago, a law degree from the University of Michigan, and a diploma in international law from the Escuela Libre de Derecho in Mexico City. I have been a Fulbright Scholar and a Woodrow Wilson Designate. My long-term interest is in the role of science in shaping a new politics and a new culture, and I have worked for a European environmental think tank in Rome, the Ford Foundation, and the U.S. Congress (on the professional staff of the Office of Technology Assessment). At OTA I co-invented (with Prof. R. Stephen Berry of the University of Chicago) a new approach called "Scientific Mediation," which lets government agencies make intelligent policy decisions on issues involving scientific uncertainty and hence controversy. I have consulted on Scientific Mediation for state governments, private corporations, and the government of Sweden, where it became standard procedure in the Ministry of Industry. I am the author of many articles that have appeared in journals such as *The Bulletin of the Atomic Scientists, Environment, Science Magazine, California Lawyer, Science* and *Global Security*.

Darrell Ryan Steely

darrell.steely@gmail.com

Education:

- **Teaching Credential**: California Single Subject, Biological Sciences, San Jose State University, 2002.
- **Master of Arts**: Biological Sciences, June 2001. Humboldt State University, Arcata, CA. Thesis title: The Life Cycle and Ecological Studies of the Digenetic Trematode, *Echinostephilla haematopi*.
- **Bachelor of Science**: Biological Sciences, Dec. 1994. University of California, Santa Barbara.

Experience:

8/99- Present **Science Teacher**: Currently teaching Advanced Placement Biology and Life Science at Pacific Collegiate School. Have previously taught AP Environmental Science, Biology, and Physical Sciences.

2008-2009 **High School Science Mentor –** Mentored two high school science research projects. Both projects received recognition at county and international Science Fairs.

2007-2009 **Science Department Chair** Mentored and supported new and experienced teachers, organized and managed department meetings and budget, and developed science curriculum for Pacific Collegiate School.

3/09-4/09 **Princeton Review –** Reviewed content, questions and revised sections of the 2010 AP Biology Study Guide

2006-2009 **Cal-Teach Mentor Teacher** – Worked and mentored UCSC science majors who are interested in pursuing a career in education.

2000-Present **Science Fair Coordinator:** Organize Pacific Collegiate School's annual science fair. This includes recruiting judges, mentoring students, and organizing the fair for public display.

2004-08 **Teacher Fellow, COSMOS.** Taught transferable skills and assisted professors in teaching science to advanced high school students at the University of California at Santa Cruz.

12/04-6/05 **Science Department Chair**: See above description

Teaching Awards and Honors

- 2009 NHSS Educator of Distinction
- Agilent Teacher Fellow at COSMOS 2008
- Santa Cruz County Science Fair Teacher of the Year 2007
- "Teacher with most Cal-Teach students" 2007
- Teacher of the Year, Pacific Collegiate School 2005
- COSMOS Teacher Fellow 2004, 2005, 2006, 2008
- California State Science Teacher of the Year 2003
- Santa Cruz County Science Fair Teacher of the Year 2003
- Santa Cruz County Science Fair Teacher of the Year 2002
- Santa Cruz County Science Fair Teacher of the Year 2001

Joel Tarbox

Pacific Collegiate School, Visual and Performing Arts Department
Address: 255 Swift Street Santa Cruz, CA 95050
Phone: 831.479.7785, **E-mail:** joel.tarbox@pcsed.org, **Web:** www.pcsart.org

Education

Bachelor of Arts (BA), Bowdoin College, Brunswick, Maine, May 1992
Major: Studio Art; Minor: French
Master of Fine Arts (MFA), Northwestern University, Evanston, Illinois, June 1996
Primary Concentration: Painting; Secondary Concentration: Printmaking
Master of Arts in Teaching (MAT), Bethany University, Scotts Valley, California, May 2008
Level I Preliminary Credential, Art, SB2042 with CLAD Emphasis, No Child Left Behind Compliant, May 2008

Professional Experience

Teaching Video Production, Graphic Design, AP Art History, Fine Art

Instructor, Department of Art, Pacific Collegiate School, Santa Cruz, CA, August 2007–Present
— Teach high school level art classes in visual arts, AP art history, and digital art, including video production and graphic design

Founder/Creative Director, Tarbox Art & Design, January 2002–Present
— Provide a full-range of graphic design agency services including production, design, art direction, illustration, copy-editing, project management, customer service, estimating, budgeting and billing

Senior Graphic Designer, HealtheTech Inc., Los Gatos, CA, July 2001–January 2002
— Developed corporate branding and identity for high-tech, health care and fitness start-up
— Applied corporate look and feel to collateral, web site, software, hardware, packaging and products

Graphic Designer/Project Coordinator, Dominican Hospital CHW, Santa Cruz, CA, May 1998–June 2001
— Established the look and feel for corporate designs and communications in multiple media for a leading health care provider

Graphic Designer, West Marine Products, Watsonville, CA, August 1996–May 1998
— Designed catalogs, sales pieces and advertisements for the nation's largest marine retailer

Freelance Graphic Designer, Evanston, IL 1995
— Contracted with agency to deliver graphic design, presentation design and desktop publishing services to local clients

Marketing Coordinator, Skyway Freight Systems, Watsonville, CA, September 1993–August 1994
— Developed presentations and sales and marketing materials for national transportation and logistics company

Digital Technology

— Expert in the use and trouble-shooting of both Mac and Windows operating systems
— Experienced with the many software applications including Apple Final Cut Pro, QuarkXpress, Adobe InDesign, Adobe PageMaker, Adobe Photoshop, Adobe Illustrator, Adobe Acrobat, Macromedia Dreamweaver, Microsoft Powerpoint, Microsoft Word and Microsoft Excel

DORIS B. ASH – Biographical Sketch

University of California
Education Department
251 Social Sciences 1
Santa Cruz, CA 95064

Tel: (831) 459-5549
FAX: (831 459-4618
Home: (650) 346 6770
e-mail: dash5@ucsc.edu

Professional Preparation

B.S.	(Science Education)	1965, Cornell University, Ithaca, NY.
M.S.	(Biology)	1968, Cornell University, Ithaca, NY.
Ph.D.	(Science Education)	1995, University of California, Berkeley, CA

Appointments

2007-present	Associate Professor, University of California, Santa Cruz
2000-2007	Assistant Professor, University of California, Santa Cruz,
1995-2000	Science Educator, Institute for Inquiry, Exploratorium
1989-1995	Ph.D. Graduate Student, with the Brown/Campione Research group
l981-1991	Science Teacher, Peninsula School, Peninsula Way, Menlo Park, 94025.

Publications - recent and closely related

Ash, D. (2008). Thematic continuities: Talking and thinking about adaptation in a socially complex urban classroom. *Journal for Research in Science Teaching 45* (1) 1 – 30.

Ash, D. (2004). Reflective scientific sense-making dialogue in two languages: The science in the dialogue and the dialogue in the science. *Science Education 88:* 855-884.

Ash, D., Brown, C., Kluger-Bell, B., & Hunter, L. (in press). Establishing hybrid communities of practice: Graduate student scientists and inquiry teaching, *Journal of College Science Teaching.*

Ash, D., Crain, R., Brandt, C., Loomis, M., Wheaton, M., & Bennett, C. (2007). Talk, tools, and tensions: Observing biological talk over time, *International Journal of Science Education 29*(12), 1581-1602.

Ash, D. & Wells, G. (2006). Dialogic inquiry in classroom and museum: Actions, tools and talk. In *Learning in Places.* Peter Lang Press.

Synergistic activities

1. Co-founder of the Informal Learning Environments Research (ILER) Special Interest Group (SIG) at AERA, which has created a presence and home for museum learning researchers.
2. Conduct research and help design teacher learning projects for science graduate students with the Center for Adaptive Optics, (CfAO), a national center housed at UCSC.
3. Development of a research program centering on science sense making in two languages, at the Monterey Bay Aquarium and Seymour Marine Discovery Center.

Workshops, special courses, and educational collaborations in past three years

1. National Conference on Informal learning data analysis, Berkeley, CA, November 2007.

2. Collaboration with the Monterey Bay Aquarium and Seymour Marine Discovery Center (NSF REC # 0133662) Shared scientific sense-making and bilingual student advancement in science: Linking family and school learning through informal learning research, (2001-2008).

3. Collaboration with the Museum of Science and Industry in Tampa Florida (NSF ISE # 0515468), Successful scaffolding strategies in urban museums: Research and practice on mediated scientific conversations with families and student (2005-2010).

SOLANA PYNE

9850 S. Maryland Pkwy Ste 5, # 471, Las Vegas, NV 89183 • Phone: (646) 233-2265 • smpyne@gmail.com

EXPERIENCE

North Africa Correspondent, GlobalPost.com May 2009 - Present
Report, shoot, write and produce video and print pieces on science and general news in Morocco and other North African countries.

Associate Producer, NOVA documentaries April 2008-April 2009
Duties included conducting interviews, scientific background research, booking, and handling field production with Producer Doug Hamilton. "Last Extinction" broadcasted March 31, 2009 and investigated the cause of the last major mass extinction in North America. It was shot in Greenland, Arizona, and Maine as well as at the NASA Ames facility in California, and Sandia National Laboratories in New Mexico. "Ocean Animal Emergency" aired November 25, 2008 and spotlighted a California Veterinary hospital that is pioneering medical care for marine Mammals.

Criminal Justice Reporter, New York 1 News April 2005-April 2008
Reported, shot, wrote and edited news stories and series. Won NY Press Club award for exposing illegal police detentions of innocent photographers. Sent to Japan for a series comparing the New York and Tokyo criminal justice systems. Traveled to the Gulf Coast to cover aftermath of Hurricane Katrina. Risked prison reporting story on Zimbabwean New Yorkers sending money to their collapsing homeland. Homeland security fellow at Johns Hopkins, SAIS, International Reporting Project.

Freelance International Correspondent, Zimbabwe Aug.-Sept. 2006
Reported, produced and shot a story for CNN International on Zimbabwean students prostituting themselves to pay for college.

The Cambodia Daily Dec. 2003-Dec. 2004
Associate Editor. Based in Phnom Penh, Cambodia. Wrote, reported and edited stories on government corruption, land conflict, illegal logging, and mismanagement of international aid.

Freelance Journalist Feb. 2002-Nov. 2003
Wrote for Science, Newsday and the Village Voice, including a Voice cover story on young adults unable to afford health insurance. Topics ranged from the latest climate change science to environmental damage resulting from the Iraq war.

Discover Magazine Sept. 2001-Feb. 2002
Editorial Assistant/Intern. Covered astronomy, geology and marine biology for the magazine and Web site and fact-checked.

Newsday June-Aug. 2001
Science Reporting Intern. Wrote science articles for the daily paper and weekly Discovery Section.

SAGE Knowledge Environment Mar.-June 2001
Took photographs for and wrote a 5,000 word feature on America's first research center to focus entirely on aging.

Scripps Institution of Oceanography, La Jolla, CA Sept.-Dec. 1999
Co-authored scientific article, "Using an optical plankton counter to determine the size distributions of preserved zooplankton samples," Stace Beaulieu, et al., published in The Journal of Plankton Research

EDUCATION

University of California Santa Cruz Sept. 2000-June 2001
Certificate: Science Communication

University of California San Diego 1995-1999
Degrees: Bachelor of Science, General Biology, Magna Cum Laude
Bachelor of Arts, Literature/Writing, Magna Cum Laude

STATEMENTS OF SUPPORT

Intent

Darrell Steely [darrell.steely@gmail.com]

Sent: Sunday, June 28, 2009 11:55 PM

To: Tara Firenzi

I acknowledge that I am identified by name as Co-Investigator to the investigation, entitled A Big History of the Universe for Secondary Education*, that is submitted by Tara Firenzi to the NASA Research Announcement* NNH09ZDA001N*, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation.*

- Darrell Steely

statement of commitment

nancy abrams [nancysview@gmail.com]

Sent: Saturday, June 27, 2009 2:47 PM

To: Tara Firenzi

I acknowledge that I am identified by name as Co-Investigator to the investigation, entitled A Big History of the Universe for Secondary Education, that is submitted by Tara Firenzi, Principal Investigator, to the NASA Research Announcement NNH09ZDA001N, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation.

--
Nancy Ellen Abrams
575 High St.
Santa Cruz, CA 95060

"Think Cosmically, Act Globally"
http://viewfromthecenter.com

Research Proposal

Joel Tarbox

Sent: Saturday, June 27, 2009 1:03 PM

To: Tara Firenzi

Dear Tara Firenzi

I acknowledge that I am identified by name as Co-Investigator to the investigation, entitled A Big History of the Universe for Secondary Education, that is submitted by Tara Firenzi to the NASA Research Announcement NNH09ZDA001N, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation.

Joel Tarbox
PCS Visual and Performing Arts Department
joel.tarbox@pcsed.org
www.pcsart.org

Doris B Ash [dorisbash@gmail.com]

Sent: Monday, June 29, 2009 8:25 PM

To: Tara Firenzi

To whom it may concern

I acknowledge that I am identified by name as Collaborator to the investigation, entitled A Big History of the Universe for Secondary Education*, that is submitted by Tara Firenzi to the NASA Research Announcement* NNH09ZDA001N*, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation.*

Doris Ash

--

Doris Ash, Ph.D.
Associate Professor
Education
University of California Santa Cruz
251 Social Science 1
dash5@ucsc.edu
http://people.ucsc.edu/~dash5/
831 459 5549

David Christian [David.Christian@humn.mq.edu.au]

Sent: Monday, June 29, 2009 11:37 PM

To: Tara Firenzi

Tara

I acknowledge that I am identified by name as Collaborator to the investigation, entitled A Big History of the Universe for Secondary Education, that is submitted by Tara Firenzi to the NASA Research Announcement NNH09ZDA001N, and that I intend to carry out all responsibilities identified for me in this proposal. I understand that the extent and justification of my participation as stated in this proposal will be considered during peer review in determining in part the merits of this proposal. I have read the entire proposal, including the management plan and budget, and I agree that the proposal correctly describes my commitment to the proposed investigation.

David Christian

Pacific Collegiate School
P.O. Box 1701
Santa Cruz, CA 95061-1701

June 26, 2009

To Whom It May Concern:

I, Chris Mercer, acknowledge that the facility and equipment belonging to Pacific Collegiate School is available for use by the team proposing "A Big History of the Universe for Secondary Education" for the duration of the proposed project (three years), unless unforeseeable circumstances arise which are beyond our control as a public charter school.

I serve as the interim Principal/Superintendent of Pacific Collegiate School, and if you have any questions, please contact me at 831-479-7785.

Sincerely,

Chris Mercer

Chris Mercer
Interim Principal/Superintendent
Pacific Collegiate School

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OFFICE OF SPONSORED PROJECTS
TEL: (831) 459-1378
FAX: (831) 459-4989

SANTA CRUZ, CALIFORNIA 95064

June 30, 2009

Subject: Subcontract on proposal titled" " A Big History of the Universe for Secondary Education."
Project Period: 01/01/10
Campus rate: 51.5% MTDC
Total Amount: 38,987

To Whom It May Concern:

This letter is written on behalf of our investigator Doris Ash, The Regents of the University of California, Santa Cruz has approved the 3-year budget for this project totaling $38,987.

We look forward to working with Pacific Collegiate School and anticipate a successful Project. If you have any questions or need additional information, please contact Sharon Collum, Contract and Grant Officer at slcollum@ucsc.edu or by (831) 459-1378

Sincerely,

Sharon L. Collum
Contract and Grant Officer

"A Big History of the Universe for Secondary Education"
BUDGET NARRATIVE

PI: Tara Firenzi
Co-Is: Joel Primack, Ph.D, Nancy Abrams, Darrell Steely, Joel Tarbox
Collaborators: Doris B. Ash, Ph.D, David Christian, Ph.D.
GSR: Zoe Buck
Consultant: Solana Pyne

The PI requests two months of summer salary per year. Co-Is Abrams, Steely, and Tarbox also request two months of summer salary per year. All PIs and Co-Is work and reside in the Santa Cruz County area, and three teach at the same institution (Firenzi, Tarbox, and Steely) so the team will not require any travel funds to be able to meet and discuss the project.

Support is requested for one UCSC graduate student, who will be supported through a sub-award to the University of California at Santa Cruz. The GSR will be supervised by collaborator Doris Ash but will also work with the rest of the team. For each grant year, the graduate student (Ms. Zoe Buck) will be supported during three months of the summer only. Please see detail below for more information.

Support is also requested for the consultant, Solana Pyne, who we estimate will spend on average 20 hours per year providing feedback and guidance at a rate of $100/hour.

For the first two years, we request that $2000 be available for potential purchase of costumes, props and/or sets. There will be no equipment costs, as Pacific Collegiate School already owns the software and high-definition cameras required for filming and editing.

For the second year, funds are requested to compensate local teachers who use the curriculum during field tests for the time they spend training to use the materials, and for the time they spend giving feedback to the team ($500).

Additionally, in the third year, travel funds are requested to allow PI Firenzi and Co-I Darrell Steely to attend national conferences and meetings in order to promote the materials developed. PI Firenzi would attend the World History Association conference, which is going to be held in a yet to be disclosed international location, and Steely will attend a conference in the United States (probably the National Science Teachers Association Conference).

In addition, funds are requested to host a conference at UCSC during the third year to train teachers about how to use the materials ($3000).

Finally, funds are requested to aid in the distribution of the materials, including the production of approximately 1,000 DVDs ($3,000), obtaining music rights (up to $3,000), placement of the curriculum in major catalogs ($500), the production of ancillary print materials ($1,000), and the maintenance of a companion website ($200).

University of California Santa Cruz
Office of Sponsored Projects
Detailed Budget

Printed on 6/30/2009

SC# 20090697
Title " A Big History of the Universe for Secondary Education"

Budget Prepared Date
Budget Revised Date
Preparer Sharon Collum
Not Submitted? ☒

PI Name Firenzi, Tara
Start Date 1/1/2010
End Date 12/31/2012
Location UCSC
IC Rate 51.50%
Agency Pacific Collegiate School
Analyst Sharon Collum
IC Type MTDC

Salaries:

Title Name	Salary Type/Level	Year 1	Year 2	Year 3	Total
GSR-Summer	GSR-Res IV	8,083	8,326	8,576	24,985
To be selected	Months/Time%	3.0 75%	3.0 75%	3.0 75%	
	Total Salaries:	8,083	8,326	8,576	24,985

Fringe:

Title Name	Salary Type/Level Fringe Rate	Year 1	Year 2	Year 3	Total
GSR-Summer	GSR-Res IV	242	250	257	749
To be selected	3.0%				

	Total Fringe:	242	250	257		749
	Total Salaries & Fringe:	8,325	8,576	8,833		25,734
Totals:						
	Total Direct Costs:	8,325	8,576	8,833		25,734
	Indirect Cost Base:	8,325	8,576	8,833		25,734
	Indirect Cost Base Override:					
	IC Rate:	51.5%	51.5%	51.5%	51.5% 51.5%	
	Total Indirect Costs:	4,287	4,417	4,549		13,253
	TOTAL BUDGET:	12,612	12,993	13,382		38,987