New Undergraduate Degree Program Conceptual Abstract

Program Name: Bachelor of Arts in Natural Sciences
Concentration: Science and Environmental Literacy

Department Contact(s) w/phone #/(s): Joel J. Mintzes, X4599

Required Signatures

The Department of Science Education, College of Natural Sciences
has reviewed and approved this conceptual abstract

[Signature]
Chair, Department Curriculum Committee
11/20/08
Date

[Signature]
Department Chair
11/20/08
Date

The College of Natural Sciences
has reviewed and approved this conceptual abstract

[Signature]
Chair, College Curriculum Committee
12/1/08
Date

[Signature]
College Dean
12/1/08
Date

Send signature page with the conceptual abstract attached to Academic Affairs,
attn: Bitsy Wagner, zip 110

I have reviewed and approve the conceptual abstract for this new degree program. It will
be sent to the Chancellor’s Office and, if approved by the CSU Board of Trustees, it will
be added to the Academic Master Plan.

[Signature]
[Date]
1. Program Type
State-Support
New Program

2. Program Identification
   2a. Campus
       Chico

   2b. Full and exact degree designation and title
       Bachelor of Arts in Natural Sciences

   2c. Date the Board of Trustees approved adding this program to the campus
       Academic Plan
       March 25, 2009

   2d. Term and Academic Year of intended implementation
       Year of intended implementation: Fall 2010

   2e. Name of the Department(s), division, or other unit(s) of the campus which would
       offer the proposed degree major program.
       Department of Science Education

   2f. Name, title, and rank of the individual(s) primarily responsible for drafting the
       proposed program.
       Ann Bykerk-Kauffman, Professor in Geological and Environmental Sciences and Science
       Education
       David Kagan, Professor in Physics and Chair of the Department of Science Education

   2g. Statement from the appropriate campus administrative authority that the
       addition of this program supports the campus mission and will not impede the successful
       operation and growth of existing academic program.
       Once this proposal receives campus approval, a cover letter from the Provost’s office will be
       attached before it is submitted to the Chancellor’s office. This document provides evidence of
       approval from campus authorities.

   2h. Any other campus approval documents that may apply.
       Assuming the proposal is approved by the EPPC/Senate and passes technical review, there will
       be a recommendation from the Senate to the President. This will be attached to this proposal
       when being finalized for submission to the Chancellor’s Office.

The Department of Science Education has created a new course, Scientific Inquiry (NSCI 321). We
intend to have NSCI 321 designated as the WP course for the B.A. in Natural Sciences. NSCI 321
will be taught for the first time in Spring 2010. This initial trial will provide the assessment data
required such as samples of student writing. The Department of Science Education has notified the
University Writing Committee of its intentions and initiated the designation process. The attached
letter indicates such notification.
2i. Please specify whether this proposed program is subject to WASC Substantive Change review

no

2j. Optional: Proposed Classification of Instructional Program (CIP) Code and CSU Degree Program Code

CSU: 49023  CIP: 30.1801

3. Program Overview and Rationale
   3a. Rationale, including a brief description of the program

The new B.A. degree in Natural Sciences is designed for students who plan to use a broad background in fundamental science concepts for an interdisciplinary career such as law, science writing, environmental policy or junior high school science teaching. The 45-unit requirement is lower than most degrees in the College of Natural Sciences, allowing the students the time and the freedom to take other courses as required or recommended depending on their future career plans.

This new degree program is an effort to realign resources to better meet students’ current needs. Discussions are currently underway in the Department of Geological and Environmental Sciences to eliminate the B.S. degree in Geoscience with an option in Physical Science Education. This elimination would occur in conjunction with the implementation of this proposed new B.A. in Natural Sciences.

3b. Proposed catalog description

See proposal part 9.

4. Goals
   4a. Goals for the (1) program and (2) student learning outcomes.

The Department of Science Education has defined a set of goals for students who will complete the proposed B.A. in Natural Science. Under each goal is a set of 3-12 student learning outcomes.

Natural Sciences Program Mission Statement
Guided by national and state education standards as well as “best practices” in science education, the Natural Sciences Program seeks to provide students pursuing a variety of career paths with a broad conceptual background in each of the natural sciences and an in-depth conceptual background in one specific area of science.

Program Goals
1) To foster students’ deep understanding of fundamental concepts in the natural sciences.

Student learning outcomes: Upon completion of the Natural Sciences Program, students will be able to clearly and completely answer in-depth questions about the following fundamental life, physical, earth and space science concepts.
a. **Astronomy**
   Explain how telescopes work and how knowledge of the structure and composition of the universe can be learned from studying stars and galaxies and their evolution. Describe and explain the cause of the regular and predictable patterns of movement of objects in the sky, including the sun, moon, stars and other planets. Demonstrate how the moon’s monthly revolution around Earth causes the phases of the moon.

b. **Dynamic Processes of the Earth (Geodynamics)**
   Explain how Earth’s features were formed by the dynamic processes that have occurred in the past and continue to occur. Use plate tectonics to account for most of the important features of Earth’s surface and major geologic events. Explain how surficial processes and agents such as waves, wind, water, and ice are slowly modifying Earth’s land surface. Describe the roles of weathering, transport, and deposition of sediment in this reshaping. Use evidence from rocks to decipher geologic history and the evolution of life on Earth. Observe properties of rocks and minerals and use them to determine their processes of formation. Identify the sun as the source of most of the energy on the Earth. Explain why Earth’s surface is heated unevenly and how that uneven heating causes air movements that result in changing weather patterns. Use an understanding of heat to explain the many phenomena on Earth’s surface that are affected by the transfer of energy through radiation and convection.

c. **Earth Resources**
   Identify the many different natural energy and material resources, including air, soil, rocks, minerals, petroleum, fresh water, wildlife, and forests, and classify them as renewable or nonrenewable. Describe how the various sources of energy and materials differ in amounts, distribution, usefulness, and the time required for their formation. Explain how the utility of energy sources is determined by factors that are involved in converting these sources to useful forms and the consequences of the conversion process. Describe the natural origin of the materials used to make common objects.

d. **Ecology**
   Describe how organisms in ecosystems exchange energy and nutrients among themselves and with the environment. Identify factors that affect organisms within an ecosystem, including natural hazards and human activity.

e. **Genetics and Evolution**
   Explain that a typical cell of any organism contains genetic instructions that specify its traits. Explain how biological evolution accounts for the diversity of species that developed through gradual processes over many generations. Describe evidence used to explain the evolution of life on Earth.

f. **Molecular Biology and Biochemistry**
   State and apply the principles of chemistry that underlie the functioning of biological systems. Describe the properties of biochemical compounds that make them essential to life.

g. **Cell and Organismal Biology**
   Demonstrate an understanding that all living organisms are composed of cells and explain important cellular processes. Describe and give examples of how the anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. Demonstrate
understanding of physical principles that underlie biological structures and functions and apply these principles to important biological systems.

h. Waves
State and describe the common characteristics of all waves. Apply knowledge of wave properties to describe and predict the behavior of waves, including light waves, sound waves, and seismic waves. Apply the simple principles of optics to explain how various lenses work.

i. Forces and Motion
Describe the motion of an object and the relationships among its velocity, speed, distance, time, and acceleration. Explain the relationship among force, mass, and acceleration. Use Newton’s laws to predict the motion of objects.

j. Electricity and Magnetism
Explain the relationship between electric and magnetic phenomena. Use knowledge of electricity and magnetism to explain many practical applications.

k. Heat Transfer and Thermodynamics
Explain how heat flows in a predictable manner. Understand that energy cannot be created or destroyed, although in many processes energy is transferred to the environment as heat. Apply this knowledge to explain how many phenomena on Earth’s surface are affected by the transfer of energy through radiation and convection currents.

l. Structure and Properties of Matter
Know that more than 100 elements of matter exist, each with distinct properties and a distinct atomic structure. Describe both macroscopic and microscopic properties of matter including intermolecular and intramolecular forces. Explain how the organization of the periodic table is based on the properties of the elements and reflects the structure of atoms. Understand how the periodic table is constructed and the periodic trends in chemical and physical properties that can be seen in the table. Recognize chemical reactions as processes that involve the rearrangement of electrons to break and form bonds with different atomic partners. Demonstrate understanding of the principles of chemistry that underlie the functioning of biological systems.

2) To develop students’ skills and abilities in science
Student learning outcomes: Upon completion of the Natural Sciences Program, students will be able to demonstrate scientific skills in the following areas:

a. Investigation and Experimentation
Formulate and conduct scientific investigations. Select appropriate scientific tools, make relevant measurements of changes in natural phenomena, and present unbiased findings in logical and meaningful formats using charts, maps, tables, models, graphs, and labeled diagrams. Apply mathematics to scientific investigations and experimentation(s) for the purpose of quantifying results and drawing conclusions. Interpret experimental results and determine whether further information is necessary to formulate accurate conclusions. Communicate results through various methods, and use technology where appropriate.

b. Nature of Science
Recognize that science is an active endeavor in which acquisition of knowledge is based upon the collection and examination of data, understanding that scientists have a responsibility to
report fully and openly the methods and results of their observations and experiments, even if those results disagree with their favored hypotheses or are controversial in public opinion. Understand that to hide data, arbitrarily eliminate data, or conceal how an experiment was conducted is to invite errors, make those errors difficult to discover, and risk harm to colleagues and communities. Understand that scientists carefully consider questions and challenges raised by fellow scientists about the assumptions, procedures, and accuracy of their experiments. Understand that a fundamental aspect of scientific inquiry is that it is dynamic and self-correcting by design. Conclusions, hypotheses, and theories are tested in every experiment and revised or rejected when they no longer correctly or accurately predict experimental results. Understand that scientists must consider the safety, ethical concerns, risks, and costs and benefits of experiments to society.

3) To develop students’ abilities to explain scientific phenomena to an audience and design learning environments that promote scientific discovery and understanding.

**Student learning outcomes:** Upon completion of the Natural Sciences Program, students will be able to...

a. Write clear and complete explanations of fundamental scientific concepts.

b. Orally explain fundamental science concepts in a clear manner, using accessible language.

c. Design visual aids, representations (graphical, mathematical, and diagrams), and live demonstrations that clearly and accurately represent fundamental scientific concepts.

d. Elicit an audience’s ideas about science concepts and help them examine, refine and restructure those ideas through activities and conversations.

e. Respectfully respond to questions about science with leading questions or critical pieces of information that engage questioners in answering their own questions.

f. Design properly scaffolded safe activities, complete with thought-provoking written questions, that can lead people to a deep understanding of science concepts.

g. Those students pursuing a career in teaching will be able to...

1. Empathize with the struggles of adolescent children in public school science classrooms.
2. Realistically discuss the challenges and rewards of public school science teaching.
3. Demonstrate a dedication to increasing scientific literacy for all students, not just those with a strong aptitude for science.
4. Identify some effective and ineffective strategies for maintaining classroom discipline while teaching science in a public secondary school science classroom.

4b. **Plans for assessing program goals and student learning outcomes**

Below is a matrix of the required and elective courses in the major, indicating how they provide students an introduction (I), practice (P), and development at mastery level (D) of the skills...
which will lead to successfully achieving the learning outcomes in the list in Section 4a. The courses are listed in approximate order that students would take them in the B.A. in Natural Science.

Course Alignment Matrix:
I = Introduced, P = Practiced with Feedback, D = Developed at Mastery Level

<table>
<thead>
<tr>
<th>Course</th>
<th>Goal 1, a-c (Earth &amp; Space Sciences)</th>
<th>Goal 1, d-g (Life Science)</th>
<th>Goal 1, h-l (Physical Science)</th>
<th>Goal 2</th>
<th>Goal 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSCI 141</td>
<td></td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>NSCI 142</td>
<td></td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>NSCI 342</td>
<td>I</td>
<td></td>
<td></td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>NSCI 343</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>NSCI 489A</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>NSCI 4XX (Inquiry)</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>D</td>
<td>D</td>
</tr>
<tr>
<td>PHYS 341</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>CHEM 107 or 111</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>GEOS 102, 105 or 265</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 302, 318, 334, or 342</td>
<td>D</td>
<td></td>
<td></td>
<td>D</td>
<td></td>
</tr>
<tr>
<td>CHEM 390 or 411, EDCI 448, GEOS 341 or 489T, NSCI 4XX or 4XY, PHYS 489T</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
<td>D</td>
</tr>
<tr>
<td>Advising pattern courses (11-13 units)</td>
<td>D (for those choosing the geology or environmental science advising pattern)</td>
<td>D (for those choosing the human biology or general biology advising pattern)</td>
<td>D (for those choosing the chemistry or physical science advising pattern)</td>
<td></td>
<td>D</td>
</tr>
</tbody>
</table>

4c. Total number of units required for major.
45-46 units

EM86-01 states that “A major leading to a liberal arts degree (B.A.) shall include not fewer than 24 nor more than 60 semester units.” The proposed BA in Natural Sciences meets this requirement.
4d. Include a justification for any baccalaureate program that requires more than 120 semester units
n/a

4e. If any formal options, concentrations, or special emphases are planned under the proposed major, identify and explain fully.
As described in the mission statement above, students will develop in-depth conceptual background in one specific area of science. The options in General Biology, Human Biology, Chemistry, Environmental Science, Geology, and Physics allow students to choose an area of science for in-depth study.

4f. A list of all courses required for the major, specifying the catalog number, title, units of credit, and prerequisites or corequisites.

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSCI 141</td>
<td>Concepts in Physical Sciences</td>
<td>3</td>
<td>NSCI 141</td>
</tr>
<tr>
<td>NSCI 142</td>
<td>Concepts in Life Science</td>
<td>3</td>
<td>NSCI 141, NSCI 142. This is a WP course.</td>
</tr>
<tr>
<td>NSCI 321</td>
<td>Scientific Inquiry</td>
<td>3</td>
<td>NSCI 141</td>
</tr>
<tr>
<td>NSCI 342</td>
<td>Concepts in Earth and Space Sciences</td>
<td>3</td>
<td>NSCI 141</td>
</tr>
<tr>
<td>NSCI 343</td>
<td>Concepts in Environmental Science</td>
<td>3</td>
<td>NSCI 142</td>
</tr>
<tr>
<td>NSCI 489A</td>
<td>Internship in Science Teaching</td>
<td>1</td>
<td>NSCI 141, 142, concurrent enrollment in or prior completion of NSCI 342</td>
</tr>
<tr>
<td>PHYS 341</td>
<td>Advanced Inquiry into Physics</td>
<td>3</td>
<td>NSCI 141 or PHYS 202 A/B or PHYS 204 A/B or PHYS 100</td>
</tr>
</tbody>
</table>

4g. List of elective courses that can be used to satisfy requirements for the major, specifying the catalog number, title, units of credit, and prerequisites or corequisites.

One course chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 107</td>
<td>General Chemistry for Applied Sciences</td>
<td>4</td>
<td>Intermediate Algebra (The Chemistry Department is in the process of modifying this requirement to read “Must have completed ELM requirements.”)</td>
</tr>
<tr>
<td>CHEM 111</td>
<td>General Chemistry</td>
<td>4</td>
<td>Second-year high school algebra; one year high school chemistry</td>
</tr>
</tbody>
</table>
### One course chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 102</td>
<td>Physical Geology</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GEOS 105</td>
<td>Introduction to Astronomy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>GEOS 265</td>
<td>Environment III: Atmosphere, Water and Soils</td>
<td>2</td>
<td>GEOS 166 (The Department of Geological and Environmental Sciences is in the process of modifying this requirement to read “GEOS 166 or NSCI 343”)</td>
</tr>
</tbody>
</table>

### One course chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 302</td>
<td>Evolution</td>
<td>3</td>
<td>BIOL 101 or BIOL 108 or equivalent (The Department of Biological Sciences is in the process of modifying this list to include NSCI 14.2)</td>
</tr>
<tr>
<td>BIOL 318</td>
<td>Biology of Childhood</td>
<td>3</td>
<td>One biological science course</td>
</tr>
<tr>
<td>BIOL 334</td>
<td>Conservation Ecology</td>
<td>3</td>
<td>BIOL 101 or equivalent (The Department of Biological Sciences is in the process of modifying this list to include NSCI 142.)</td>
</tr>
<tr>
<td>BIOL 342</td>
<td>Field Biology</td>
<td>3</td>
<td>BIOL 101 or BIOL 108 (The Department of Biological Sciences is in the process of modifying this list to include NSCI 142.)</td>
</tr>
</tbody>
</table>

### One course chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 489</td>
<td>Internship in Biology: Leadership in Science Teaching</td>
<td>1</td>
<td>Necessary background for the specific internship.</td>
</tr>
<tr>
<td>CHEM 390</td>
<td>Special Problems in Science Education</td>
<td>1-3</td>
<td>CHEM 111, faculty permission.</td>
</tr>
<tr>
<td>CHEM 411</td>
<td>Chemistry Teaching Methods</td>
<td>3</td>
<td>CHEM 112, CHEM 270</td>
</tr>
<tr>
<td>EDCI 448</td>
<td>Methods and Materials for Environmental Education</td>
<td>3</td>
<td>BIOL 342 or GEOS 130 or equivalent</td>
</tr>
<tr>
<td>GEOS 341</td>
<td>Teaching Practicum in Geological and Environmental Sciences</td>
<td>3</td>
<td>GEOS 102, GEOS 105, GEOS 203, GEOS 306, GEOS 321 (The Dept. of Geological and Environmental Sciences is in the process of modifying this list to “NSCI 342 or GEOS 102 and 105”)</td>
</tr>
<tr>
<td>GEOS 489T</td>
<td>Internship in Geoscience Teaching</td>
<td>3</td>
<td>GEOS 101 or 102, GEOS 105, GEOS 203, Corequisites: GEOS 300, GEOS 306, GEOS 307 (The Department of</td>
</tr>
<tr>
<td>Course</td>
<td>Title</td>
<td>Units</td>
<td>Prerequisites</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------</td>
<td>-------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>PHYS 489T</td>
<td>Internship in Physics Teaching</td>
<td>3</td>
<td>PHYS 300B and faculty permission</td>
</tr>
</tbody>
</table>

One sequence chosen from:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 151</td>
<td>Principles of Cellular and Molecular Biology</td>
<td>4</td>
<td>Recommend CHEM 111 or concurrent enrollment.</td>
</tr>
<tr>
<td>BIOL 152</td>
<td>Principles of Ecological, Evolutionary, and Organismal Biology</td>
<td>4</td>
<td>BIOL 151 or faculty permission; recommend CHEM 112 or concurrent enrollment.</td>
</tr>
<tr>
<td>BIOL 153</td>
<td>Principles of Physiology and Development</td>
<td>4</td>
<td>BIOL 151: CHEM 112 or concurrent enrollment recommended.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 103</td>
<td>Human Anatomy</td>
<td>4</td>
<td>A college course in biology or in general chemistry</td>
</tr>
<tr>
<td>BIOL 104</td>
<td>Human Physiology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>BIOL 211</td>
<td>Allied Health Microbiology</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 112</td>
<td>General Chemistry</td>
<td>4</td>
<td>CHEM 111 with a grade of C- or higher.</td>
</tr>
<tr>
<td>CHEM 270</td>
<td>Organic Chemistry</td>
<td>4</td>
<td>CHEM 112</td>
</tr>
<tr>
<td>CHEM 350/ CHEM 350L</td>
<td>Introductory Biochemistry</td>
<td>4</td>
<td>CHEM 108</td>
</tr>
<tr>
<td>or CHEM 370/ CHEM 370L</td>
<td>Organic Chemistry</td>
<td>4</td>
<td>CHEM 270 with a grade of C- or higher.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 300</td>
<td>Earth System Science</td>
<td>3</td>
<td>ENGL 130 (or its equivalent) with a grade of C- or higher; CHEM 107 or CHEM 111; PHYS 202A, PHYS 202B or PHYS 204A, PHYS 204B or PHYS 204C (The Department of Geological and Environmental Sciences is in the process of adding PHYS 341 to the list of possible Physics courses that could meet the prerequisite requirements)</td>
</tr>
<tr>
<td>GEOS 365</td>
<td>Environment IV: Environmental Science Applications</td>
<td>2</td>
<td>GEOS 265 or faculty permission</td>
</tr>
<tr>
<td>GEOS 370</td>
<td>Energy in the Human Environment</td>
<td>3</td>
<td>One course from Breadth Area B1</td>
</tr>
</tbody>
</table>
GEOS 460  Water Resources Management  3  Upper-division standing: GEOS 330 or 380  (The Department of Geological and Environmental Sciences is in the process of adding NSCI 343 to this list.)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOS 203</td>
<td>Principles of Historical Geology</td>
<td>3</td>
<td>GEOS 101 or GEOS 102</td>
</tr>
<tr>
<td>GEOS 306</td>
<td>Mineralogy and Lithology</td>
<td>4</td>
<td>GEOS 101 or GEOS 102</td>
</tr>
<tr>
<td>GEOS 307</td>
<td>Stratigraphy</td>
<td>3</td>
<td>GEOS 203 and GEOS 306 (both may be taken concurrently), or faculty permission.</td>
</tr>
<tr>
<td>GEOS 303 or 325</td>
<td>Invertebrate Paleontology</td>
<td>3</td>
<td>GEOS 203 or course in biology.</td>
</tr>
<tr>
<td>or GEOS 360</td>
<td>Field Methods</td>
<td>2</td>
<td>GEOS 306, 307</td>
</tr>
<tr>
<td>or GEOS 360</td>
<td>Geology of California</td>
<td>3</td>
<td>GEOS 101 or 102 or consent of instructor.</td>
</tr>
<tr>
<td>PHYS 202A</td>
<td>General Physics</td>
<td>4</td>
<td>High school physics or faculty permission. High school trigonometry and second year high school algebra or equivalent (MATH 051 and MATH 118 at CSU Chico).</td>
</tr>
<tr>
<td>PHYS 202B</td>
<td>General Physics</td>
<td>4</td>
<td>PHYS 202A</td>
</tr>
<tr>
<td>CHEM 112 or 108</td>
<td>General Chemistry</td>
<td>4</td>
<td>CHEM 111 with a grade of C- or higher.</td>
</tr>
<tr>
<td>or CHEM 108</td>
<td>Organic Chemistry for Applied Sciences</td>
<td>4</td>
<td>CHEM 107 or 111 or equivalent.</td>
</tr>
</tbody>
</table>

4h. List of any new courses that are (1) needed to initiate the program and (2) needed during the first two years after implementation.

(1) Needed to initiate the program
This program consists primarily of existing courses that are required in existing programs. All of the lower-division courses in the program are already well-established. Thus no new courses are needed in order to initiate the program.

(2) Needed during the first two years: The course below has already been proposed and is in the university review process.
PHYS 341 Advanced Inquiry into Physics 3.0 units

Proposed Catalog Description: This course builds on concepts developed in the introductory physics course in greater mathematical and representational sophistication. Topics addressed include kinematics, electrostatics and electrodynamics, simple machines, and wave phenomena.
4i. **Attach a proposed course-offering plan for the first three years of program implementation**

The courses involved in the proposed *B.A. in Natural Sciences* also fulfill requirements in other science majors and in the Liberal Studies major. Thus, once this new degree is put into effect, the course offerings will not differ substantially from those already being offered.

<table>
<thead>
<tr>
<th>Fall 2010</th>
<th>Spring 2011</th>
<th>Fall 2011</th>
<th>Spring 2012</th>
<th>Fall 2012</th>
<th>Spring 2013</th>
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</thead>
<tbody>
<tr>
<td>NSCI 141</td>
<td>NSCI 141</td>
<td>NSCI 141</td>
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<td>NSCI 142</td>
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<tr>
<td>NSCI 321</td>
<td>NSCI 321</td>
<td>NSCI 321</td>
<td>NSCI 342</td>
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<td>NSCI 343</td>
<td>NSCI 489A</td>
<td>NSCI 343</td>
<td>NSCI 489A</td>
<td>NSCI 343</td>
<td>NSCI 489A</td>
</tr>
<tr>
<td>NSCI 489A</td>
<td>BIOL 103</td>
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<td>BIOL 103</td>
<td>NSCI 489A</td>
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<td>BIOL 103</td>
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<td>BIOL 104</td>
<td>BIOL 151</td>
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<td>BIOL 151</td>
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<td>BIOL 153</td>
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<td>BIOL 211</td>
<td>BIOL 302</td>
<td>BIOL 318</td>
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<td>CHEM 270L</td>
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<tr>
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<tr>
<td>GEOS 102</td>
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<tr>
<td>GEOS 105</td>
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<td>GEOS 105</td>
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<tr>
<td>GEOS 203</td>
<td>GEOS 203</td>
<td>GEOS 203</td>
<td>GEOS 203</td>
<td>GEOS 203</td>
<td>GEOS 203</td>
</tr>
<tr>
<td>GEOS 265</td>
<td>GEOS 341</td>
<td>GEOS 265</td>
<td>GEOS 265</td>
<td>GEOS 265</td>
<td>GEOS 265</td>
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<tr>
<td>GEOS 300</td>
<td>GEOS 360</td>
<td>GEOS 300</td>
<td>GEOS 341</td>
<td>GEOS 300</td>
<td>GEOS 360</td>
</tr>
<tr>
<td>GEOS 306</td>
<td>GEOS 365</td>
<td>GEOS 306</td>
<td>GEOS 306</td>
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<td>GEOS 365</td>
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<tr>
<td>GEOS 307</td>
<td>GEOS 370</td>
<td>GEOS 307</td>
<td>GEOS 365</td>
<td>GEOS 307</td>
<td>GEOS 370</td>
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<td>GEOS 341</td>
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<td>GEOS 341</td>
<td>GEOS 341</td>
<td>GEOS 460</td>
</tr>
<tr>
<td>PHYS 202A</td>
<td>PHYS 202A</td>
<td>PHYS 202A</td>
<td>PHYS 460</td>
<td>PHYS 202A</td>
<td>PHYS 202A</td>
</tr>
<tr>
<td>PHYS 202B</td>
<td>PHYS 202B</td>
<td>PHYS 202B</td>
<td>PHYS 202B</td>
<td>PHYS 202B</td>
<td>PHYS 202B</td>
</tr>
</tbody>
</table>

4j. **For master’s degree proposals, include evidence that program requirements conform to the minimum requirements for a culminating experience.**

n/a
4k. Admission criteria, including prerequisite coursework
Normal campus regulations governing student admission to CSU Chico apply: there are no extra criteria for this program.

4l. Criteria for student continuation in the program.
Normal campus regulations governing adequate student progress towards an undergraduate degree apply: there are no extra criteria for this program.

4m. For undergraduate programs, planned provisions for articulation of the proposed major with community college programs.
The following courses included in the major have equivalent courses taught at California community colleges:
BIOL 103, 104, 151, 152, 153, 211
CHEM 107, 108, 111, 112, 270
GEOS 102, 105, 203
NSCI 141, 142
PHYS 202A, 202B

Students could complete any or all of these classes at a California community college and be able to transfer all of their credit towards the B.A. in Natural Sciences.

4n. Lower-Division Transfer Pattern
The lower-division transfer pattern currently in place for Liberal Studies, Biology, Chemistry, Environmental Science, Geology, and Physics (found at http://www.calstate.edu/acadaff/lotp/agreements.shtml) are applicable for the new B.A. in Natural Sciences.

4o. Advising Roadmaps
See Major Academic Plan (MAP) on next page.

4p. Provision for meeting accreditation requirements, where applicable, and anticipated date of accreditation request.
We are in the process of applying for waiver-program status for this program with the California Commission on Teacher Credentialing as subject matter preparation for a single-subject teaching credential in foundational-level science.
## Major: Natural Sciences (BA)

<table>
<thead>
<tr>
<th>Major Units: 45</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First Semester</strong></td>
</tr>
<tr>
<td>NSCI 141</td>
</tr>
<tr>
<td>*<em>GE Area A [<em>1]</em></em></td>
</tr>
<tr>
<td>*<em>GE Area A [<em>1]</em></em></td>
</tr>
<tr>
<td>*<em>GE Area C [<em>2]</em></em></td>
</tr>
<tr>
<td>POLS 155 or HIST 130</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Third Semester</strong></th>
<th><strong>Fourth Semester</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NSCI 342</td>
<td>3</td>
<td>CHEM 107 or 111 (GE Area B1)</td>
</tr>
<tr>
<td>*<em>GE Area C [<em>2]</em></em></td>
<td>3</td>
<td><strong>POLS 155 or HIST 130</strong></td>
</tr>
<tr>
<td>*<em>GE Area D3 or D1 [<em>2]</em></em></td>
<td>3</td>
<td>*<em>GE Area D2 [<em>2]</em></em></td>
</tr>
<tr>
<td><strong>GE Area E</strong></td>
<td>3</td>
<td>*<em>GE Area C [<em>2]</em></em></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>14-15</td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Fifth Semester</strong></th>
<th><strong>Sixth Semester</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>NSCI 489A</td>
<td>1</td>
<td>NSCI 321 (Scientific Inquiry)</td>
</tr>
<tr>
<td>One of the following: BIOL 489; CHEM 390, CHEM 411; GEOS 341, GEOS 489T; PHYS 489T; EDCI 448</td>
<td>1-3</td>
<td>PHYS 341 (Advanced Inquiry into Physics)</td>
</tr>
<tr>
<td>BIOL 302, 318, 334 or 342</td>
<td>3</td>
<td>Advising pattern course(s)</td>
</tr>
<tr>
<td>Advising pattern course(s)</td>
<td>2-4</td>
<td>GE UD Theme</td>
</tr>
<tr>
<td><strong>GE UD Theme</strong></td>
<td>3</td>
<td>Elective(s)</td>
</tr>
<tr>
<td><strong>Elective(s)</strong></td>
<td>1-5</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>15</td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Seventh Semester</strong></th>
<th><strong>Eighth Semester</strong></th>
<th><strong>Comments</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Advising pattern course(s)</td>
<td>2-4</td>
<td>Advising pattern course(s) if needed</td>
</tr>
<tr>
<td><strong>GE UD Theme</strong></td>
<td>3</td>
<td>Elective(s)</td>
</tr>
<tr>
<td>Course(s) selected from any courses in the core or any option, which will not be used to meet other requirements in the major</td>
<td>1-5</td>
<td></td>
</tr>
<tr>
<td><strong>Elective(s)</strong></td>
<td>3-9</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>15</td>
<td><strong>TOTAL</strong></td>
</tr>
</tbody>
</table>

120 units required for degree.
5. Need for the Proposed Degree Major Program

5a. List of other California State University campuses currently offering or projecting the proposed degree major program; list of neighboring institutions, public and private, currently offering the proposed degree major program.

Currently three CSU campuses offer BA degrees in Natural Sciences: Bakersfield, Fresno, and San Jose State. Like our proposed program, all of these degrees are designed, in part, to provide subject matter competence to future public school teachers.

5b. Differences between the proposed program and programs listed in Section 5a above.

The table below compares the unit requirements for the proposed the B.A. in Natural sciences program at CSU Chico with those for the other 3 CSU campuses that offer such a degree. The unit requirements at CSU Bakersfield have been converted from quarter units. Our program most closely resembles the program at Bakersfield. There is a significant difference between the two, however. The program at Bakersfield is not approved by the California Commission on Teacher Credentialing (CCTC) as a waiver program; students must pass the appropriate California Subject Matter Examinations for Teachers (CSET) exam in order to demonstrate subject matter competency. It is our aim to obtain waiver-program status for this proposed BA in Natural Sciences at CSU Chico as a subject matter preparation program for a single subject credential in foundational-level science.

Table 1: B.A. Programs in Natural Sciences at Chico (proposed) and elsewhere in the CSU

<table>
<thead>
<tr>
<th>Campus</th>
<th>Required Units in Biological Science</th>
<th>Required Units in Chemistry</th>
<th>Required Units in Physics</th>
<th>Required Units in Earth and Space Sciences</th>
<th>Required Units in Interdisciplinary Science</th>
<th>Units that can be chosen from among the sciences</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chico (proposed)</td>
<td>6¹</td>
<td>5²</td>
<td>5³</td>
<td>5-6⁴</td>
<td>4</td>
<td>20-21</td>
<td>45</td>
</tr>
<tr>
<td>Bakersfield*</td>
<td>9</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>0</td>
<td>17</td>
<td>48</td>
</tr>
<tr>
<td>Fresno**</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>11</td>
<td>3</td>
<td>23-31 (4 units math subtracted)</td>
<td>67-75</td>
</tr>
<tr>
<td>San Jose***</td>
<td>23</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>0</td>
<td>43</td>
</tr>
</tbody>
</table>

1. This includes NSCI 142, which is predominantly about biology.
2. This includes one of the three units of NSCI 141, which has a chemistry component.
3. This includes two of the three units of NSCI 141, which has a strong physics component.
4. This includes NSCI 342, which is predominantly Earth and space science.

*This is designed for students who wish to obtain subject matter competency certification for a single-subject teaching credential in science with a concentration in two specific sciences by passing the appropriate California Subject Matter Examinations for Teachers (CSET) exams.

**This major is an approved waiver program (old certification) for subject matter competency toward a single-subject teaching credential in science.

***This major is designed for students who wish to obtain subject matter competency for a multiple subject teaching credential to teach elementary or middle school science.
5c. List of other curricula currently offered by the campus that are closely related to the proposed program.
This proposed program significantly and deliberately overlaps with the science content courses for the Liberal Studies major. A total of 13 units within this proposed program consist of required courses for all students majoring in Liberal Studies. An additional 13 units of course work are shared by this proposed program and the Area of Concentration in Science within the Liberal Studies major. This overlap of course work between the two majors allows a Liberal Studies major to earn a double major in Natural Sciences by completing an additional 19 units of course work beyond that already required of a Liberal Studies major.

Another degree program that overlaps with this proposed B.A. in Natural Sciences is the B.S. in Geosciences with an Option in Physical Science Education, which was also designed to provide a broad interdisciplinary background in the sciences. Upon the approval of the B.A. in Natural Sciences, the Option in Physical Science Education within the B.S. in Geosciences will be eliminated.

5d. Community participation, if any, in the planning process  n/a

5e. Applicable workforce demand projections and other relevant data.
The B.A. in Natural Sciences will help CSU Chico prepare students to (1) enter a teaching credential program and pursue a single-subject teaching credential in foundational-level science, (2) attend law school to pursue a career in environmental law, patent law, or other law practices that require a scientific background, or (3) directly enter fields such as science writing, scientific illustrating, environmental advocacy, business consulting, sustainability, or any other profession in which a candidate would benefit from a broad, liberal background across all of the natural sciences emphasizing conceptual understanding of fundamental concepts, critical thinking and problem-solving skills.

There is an especially great need in California for well-trained foundational-level science teachers. In August, 2008, the California Commission on Teacher Credentialing (CCTC) approved a new Foundational-Level General Science authorization for a single subject credential. According to the CCTC, “The new Foundational-Level General Science Credential authorizes instruction in general and introductory science in grades K-12, and integrated science grades K-8.” This credential was created in order to fill a significant gap in teacher preparation in California. According to the 2007 report, *Critical Path Analysis of California’s Science and Mathematics Teacher Preparation System,* fewer than half of middle school science teachers hold a single-subject science credential. Although, under California law, a multiple-subject credential qualifies individuals to teach middle school science, this credential requires minimal science preparation and fails to qualify candidates for the “highly qualified” status they require under the federal *No Child Left Behind Act of 2001.* Our proposed Bachelor of Arts Degree in Natural Sciences will be an ideal program for students pursuing the new foundational-level general science teaching credential.

Universities across California have been issued a mandate to increase the number of science and mathematics teachers in the state dramatically: doubled from 2005 levels by 2010. This program can help solve that problem by expediting the degree process for future junior high school science teachers. We plan to apply to the CCTC for approval for the new B.A. in Natural Science degree as an acceptable Subject Matter Preparation Program (waiver program) leading to a clear credential for teaching foundational level science. Preliminary communications with
officers at the CCTC indicate a high likelihood of approval. As of October, 2009, CSU Chico is one of only five institutions, statewide, to have any approved subject matter programs in science at all. Furthermore, CSU Chico is one of only three institutions statewide to have an approved subject matter program for foundational-level science (The other institutions are San Diego State University and Loyola Marymount University.). This proposed B.A. in Natural sciences will provide an alternative pathway toward subject matter competence in foundational level science, allowing students to take courses that are designed for future teachers instead of the currently approved courses, which are designed for students pursuing highly technical careers in specialized science fields.

According to the 2008-2009 edition of the U.S. Department of Labor’s *Occupational Outlook Handbook*, “Job opportunities for teachers over the next 10 years will vary from good to excellent, depending on the locality, grade level, and subject taught… Currently, many school districts have difficulty hiring qualified teachers in some subject areas—most often mathematics, science (especially chemistry and physics), bilingual education, and foreign languages.”

The demand for science writers is also expected to be very good. According to the 2008-2009 edition of the U.S. Department of Labor’s *Occupational Outlook Handbook*, “Opportunities should be best for technical writers and those with training in a specialized field. Demand for technical writers and writers with expertise in areas such as law, medicine, or economics is expected to increase because of the continuing expansion of scientific and technical information and the need to communicate it to others. Legal, scientific, and technological developments and discoveries generate demand for people to interpret technical information for a more general audience. Rapid growth and change in the high-technology and electronics industries result in a greater need for people to write users’ guides, instruction manuals, and training materials. This work requires people who not only are technically skilled as writers, but also are familiar with the subject area.”

**6a. Compelling evidence of student interest in enrolling in the proposed program**

A significant number of CSU Chico students are interested in a B.A. degree in Natural Sciences. In September 2009, we polled 359 students who were enrolled in science courses in order to meet a graduation requirement. These students had all chosen majors outside of the sciences. Yet almost a third of these students expressed some degree of interest in pursuing a B.A. degree in Natural Science such as the one we are proposing. Thirty three of these students were very interested in such a degree.

The question we posed was as follows: “We are developing a 45-unit BA in Natural Sciences (no math requirement beyond GE math) designed as a waiver program (i.e. CSET waived) for the new Foundational Level Science teaching credential, which qualifies you to teach junior-high science. This degree would also be a good one for those pursuing careers such as science writing, environmental law, sustainability, or land-use planning. Would you be interested in pursuing such a degree?”

The table below shows the results of the poll.
### Course of Interest

<table>
<thead>
<tr>
<th>Course</th>
<th>Very Interested</th>
<th>Somewhat Interested</th>
<th>Number of Students Polled</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Geology (a General Education course for non-science majors)</td>
<td>4</td>
<td>33</td>
<td>153</td>
</tr>
<tr>
<td>Concepts in Life Science (a required course in the Liberal Studies program)</td>
<td>7</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td>Concepts in Physical Science (a required course in the Liberal Studies program)</td>
<td>6</td>
<td>14</td>
<td>72</td>
</tr>
<tr>
<td>Concepts in Earth and Space Sciences (a required course in the Liberal Studies program)</td>
<td>16</td>
<td>21</td>
<td>74</td>
</tr>
<tr>
<td>Totals</td>
<td>33</td>
<td>77</td>
<td>359</td>
</tr>
</tbody>
</table>

#### 6b. Issues of access considered with planning this program

n/a

#### 6c. For master’s degree proposals, the number of declared undergraduate major and the degree production over the preceding three years for the corresponding baccalaureate program.

n/a

#### 6d. Professional uses of the proposed degree major program.

Upon completion of the degree program, provided that students have a GPA of at least 2.67, they will have completed the *Single Subject Teaching Credential in Foundational-Level Science* subject matter competency requirement and be qualified to enroll in the teaching credential program in any teaching credential program in California. Upon finishing their teaching credential, they may be hired by school districts to teach 9th grade introductory science or middle school science.

Upon completion of the degree program and, in some cases, a few other courses, students will be eligible to apply to law school or to graduate programs in fields such as journalism and technical illustration.

#### 6e. The expected number of majors in the year of initiation and three years and five years thereafter. The expected number of graduates in the year of initiation and three years and five years thereafter.

This type of predication is difficult to make because, historically, CSU Chico has not offered any B.A. degrees in the basic sciences. In September, 2009, approval was granted by the CSU Chancellor’s office for a B.A. in Chemistry, but as of this writing (October 2009), the program is so new that students haven’t even had the chance to enroll yet. That said, because of the high demand for middle school science teachers with “highly qualified” status under the *No Child Left Behind Act of 2001*, we do expect significant numbers of students to enroll in the program.

<table>
<thead>
<tr>
<th>Year of Inception</th>
<th>Number of Majors</th>
<th>Numbers of Graduates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of inception</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>3 years hence</td>
<td>24</td>
<td>4</td>
</tr>
<tr>
<td>5 years hence</td>
<td>40</td>
<td>10</td>
</tr>
</tbody>
</table>

#### 7. Existing Support Resources for the Proposed Degree Major Program
7a. Faculty members who would teach in the program.
The following table contains the information for the faculty in the Department of Science Education, who would be primarily responsible for teaching of all NSCI lecture courses and most lab sections. Additional courses in the program will be taught by faculty in the departments of Geological and Environmental Sciences, Chemistry and Biochemistry, Biological Sciences, and Physics.

**Faculty with Appointments in the Department of Science Education (as of October 2009)**

<table>
<thead>
<tr>
<th>Faculty Member</th>
<th>Rank</th>
<th>Appointment in Dept. of Science Education</th>
<th>Highest Degree</th>
<th>Date</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leslie Atkins</td>
<td>Assistant Professor</td>
<td>80%</td>
<td>Ph.D.</td>
<td>2004</td>
<td>Physics Education</td>
</tr>
<tr>
<td>David Kagan</td>
<td>Professor</td>
<td>20%</td>
<td>Ph.D.</td>
<td>1981</td>
<td>Physics</td>
</tr>
<tr>
<td>Ann Bykerk-Kauffman</td>
<td>Professor</td>
<td>40%</td>
<td>Ph.D.</td>
<td>1990</td>
<td>Structural Geology</td>
</tr>
<tr>
<td>Tanya Heaston</td>
<td>Lecturer</td>
<td>100%</td>
<td>M.S.</td>
<td>2006</td>
<td>Science Teaching</td>
</tr>
<tr>
<td>Beverly Marcum</td>
<td>Professor</td>
<td>10%</td>
<td>Ph.D.</td>
<td>1974</td>
<td>Biology</td>
</tr>
<tr>
<td>Joel Mintzes</td>
<td>Professor</td>
<td>80%</td>
<td>Ph.D.</td>
<td>1974</td>
<td>Biology Education</td>
</tr>
<tr>
<td>Julie Monet</td>
<td>Assistant Professor</td>
<td>80%</td>
<td>Ed.D.</td>
<td>2006</td>
<td>Geology Education</td>
</tr>
<tr>
<td>James Pushnik</td>
<td>Professor</td>
<td>20%</td>
<td>Ph.D.</td>
<td>1989</td>
<td>Environmental Physiology</td>
</tr>
<tr>
<td>Irene Salter</td>
<td>Assistant Professor</td>
<td>100%</td>
<td>Ph.D.</td>
<td>2002</td>
<td>Neuro-biology</td>
</tr>
</tbody>
</table>

**Faculty Affiliated with the Department of Science Education (as of October 2009)**

<table>
<thead>
<tr>
<th>Faculty Member</th>
<th>Rank</th>
<th>Highest Degree</th>
<th>Date</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al Schademan</td>
<td>Assistant Professor</td>
<td>Ph.D.</td>
<td>2008</td>
<td>Teaching and Curriculum</td>
</tr>
<tr>
<td>Michael Kotar</td>
<td>Professor</td>
<td>Ed.D.</td>
<td>1980</td>
<td>Curriculum and Instruction (specialty in Science Education)</td>
</tr>
<tr>
<td>Christopher Nichols</td>
<td>Associate Professor</td>
<td>Ph.D.</td>
<td>1999</td>
<td>Organic Chemistry</td>
</tr>
<tr>
<td>Xueli Zou</td>
<td>Associate Professor</td>
<td>Ph.D.</td>
<td>2000</td>
<td>Physics Education</td>
</tr>
</tbody>
</table>
7b. Space and facilities that would be used in support of the proposed program. 
Show how this space is currently used and what alternate arrangements, if any, will be made for the current occupants.
The current space occupied by the Department of Science Education and the other departments in the College of Natural Sciences will be adequate to accommodate the new program. As an interdisciplinary degree program, the B.A. in Natural Sciences will draw upon existing courses, space and facilities within the College, and our estimate of enrollment does not substantially change the current usage. Current enrollment in “Core Requirements” includes approximately 75-125 students/semester in each of BIOL 101, 342, GEOS 141, 342 and NSCI 489b. Those courses occupy some lecture and laboratory space in AYRS 120, PLM 102, PHSC 105, 226, 232, HLT 125, and 170. Two of these spaces (HLT 125 and PHSC 226) have been “dedicated” for use in the current science program for Liberal Studies students and will continue to function in this capacity in the new degree program and will also serve students enrolled in NSCI 321 and PHSC 341. Additional space and facilities for “elective courses” are currently administered by the Departments of Biological Sciences, Chemistry and Biochemistry, Geology and Environmental Sciences, and Physics. The new degree program will not substantially change the allocation or distribution of space or facilities usage within any of these Departments.

7c. A report provided by the campus library, detailing resources available to support the program.

Reported by Joseph Crotts, Earth and Physical Sciences Librarian, Meriam Library

The Meriam Library maintains a comprehensive collection of books and periodicals to support existing undergraduate and graduate programs in: Biological Sciences (B.S in biological sciences, microbiology; M.S. in biological sciences, botany); Chemistry (B.S); Geological and Environmental Sciences (B.S. in geology, geosciences; M.S. in geosciences, environmental science); Physics (B.S.), science education, and a single subject teaching credential in science. The main book collection numbers approximately 33657 titles distributed as follows: 4457 in general science; 1646 in astronomy; 5238 in physics; 4942 in chemistry; 5658 in geology; 11,716 in biological sciences. The science education collection in the Curriculum section numbers approximately 450 books and 60 kits. The main book collection and science education collections are largely contemporary collections due to an exhaustive weeding project during the past two years.

Annual expenditure for books in the main collection in these combined areas is approximately $18,000, adding approximately 135 books new books to the collection at an average of $118 per book. The annual expenditure in the curriculum collection is $2000, adding approximately 100 items.

Access to periodical literature, primarily online, full text, is provided through 12 major databases to the sciences accessible through the Meriam Library Research Station web site: Academic Search, American Chemical Society, Biological Abstracts, CAB Abstracts, Environment Abstracts (print only), Geobase, Georef, JSTOR, Oxford Journals, Science Direct, and Wiley Interscience. Access through these databases is provided to approximately 7000 periodicals in biology, chemistry, earth science, and physics. Access is also provided to e books, reference works, book series, and handbooks through these databases. In addition to these comprehensive databases, access to 14 specialized databases is provided through the “Articles and Databases” page on the Subject pages for Biological Sciences, Chemistry, Geological and Environmental
Sciences, and Physics. Access to selected reference works, websites, and literature guides is also provided through the “Websites,” “Reference,” and “Guides” pages on these Subject pages. Access to the literature of teaching, including journal articles, conference papers, and teacher developed materials, is provided through the ERIC (Educational Resources Information Center) database.

7d. Existing academic technology, equipment and other specialized materials currently available.
The B.A. in Natural Sciences will draw upon existing technology, equipment and specialized materials within the College, and our estimate of enrollment in the degree program suggests that implementation of the program will not substantially change the current usage. The “Core Requirements” for the degree program will be taught largely in regular and “smart” classrooms and laboratories that are currently in use by faculty in the Department of Science Education and other science departments within the College. These and the elective courses in Biological Sciences, Chemistry and Biochemistry, Geological and Environmental Sciences and Physics are equipped and supplied through annual OE (Operating Expenses) budget allocations. Within the College, stockroom personnel in Holt Hall and the Physical Sciences Building normally prepare and set up laboratory and activity equipment and supplies. We do not anticipate any additional costs associated with technology, equipment, materials or supplies as this program is implemented. An exhaustive list of technology, equipment, materials and supplies would be quite lengthy, however examples of technology and equipment currently available within the College follows:

- Ammeters
- Animals and Plants (living and prepared)
- Aquaria
- Autoclaves
- Balances
- Barometers
- Batteries
- Bunsen burners
- Calorimeters
- Camcorders/cameras
- Centrifuges
- Chemical reagents
- Charts (wall)
- Chromatography equipment
- Conduction/convection equipment
- Coulomb meters
- Dissecting equipment
- Dynamometers
- Electronic components
- Energy transfer apparatus
- Field equipment and supplies
- Freezers/refrigerators
- Galvanometers
- Geological maps
- Glassware
- Globes
- Icemakers
- Joulemeters
- Lamps
- Lasers
- Magnetometers
- Maps
- Microcomputers and software (CD Roms)
- Microscopes and equipment
- Microwave apparatus
- Models (biological, geological, physical)
- Newtonian mechanics equipment
- Oscilloscopes
- Ovens
- pH meters
- Potentiometers
- Power supply equipment
- Probeware and sensors
- Projectors, LCDs
- Rock and Mineral specimens and equipment
- Safety equipment (goggles, helmets, gloves, fire extinguishers, masks)
- Solenoid
- Spectrophotometers
- Telescope
- Transformers
- Voltmeters
- Waterbaths
8. Additional Support Resources Required
No additional resources required.

8a. Any special characteristics of the additional faculty or staff support positions needed to implement the proposed program.
Initially, no additional faculty or staff support positions will be needed to implement this program. Only one new course, PHYS 341, was designed for this program. It will be taught once a year and require 3.6 WTU of faculty time. However, since this course is also intended to play a major role in the Science Concentration within the Liberal Studies major, this faculty time would be required whether or not this degree proposal is approved.

8b. The amount of additional lecture and/or laboratory space required to initiate and sustain the program over the next five years.
None. The one new class will be offered in existing classrooms on the CSU Campus.

8c. A report written in consultation with the campus librarian, indicating additional library resources needed. Indicate the commitment of the campus to purchase or borrow through interlibrary loan these additional resources.
No additional resources will be required. Access to science books and journals currently provided by the library are comprehensive and adequate. Please see the response to item 7c.

8d. Additional academic technology, equipment or specialized materials that will be needed to implement the program. Indicate the source of funds and priority to secure these resource needs.
None.
9. Catalog Copy

THE BACHELOR OF ARTS IN NATURAL SCIENCES

Total Course Requirements for the Bachelor’s Degree: 120 units

See “Requirements for the Bachelor's Degree” in the University Catalog for complete details on general degree requirements. A minimum of 40 units, including those required for the major, must be upper division.

A suggested Major Academic Plan (MAP) has been prepared to help students meet all graduation requirements within four years. Please request a plan from your major advisor or view it and other current advising information at http://em.csuchico.edu/aap/ProgramSearch.

This degree is appropriate for students pursuing single subject matter preparation in Foundational-Level General Science. Thus it helps fulfill one of the requirements for admission into a single subject teaching credential program. See the Single Subject Matter Preparation Program in Science section which follows for more information.

This degree is also designed for students who are interested in science-related interdisciplinary careers such as science writing, law, or environmental policy. Students who choose this program should consult with their major advisor about career paths.

General Education Requirements: 48 units

See “General Education Requirements” in the University Catalog and the Class Schedule for the most current information on General Education Requirements and course offerings. The course requirements marked below with an asterisk (*) may also be applied toward General Education.

Diversity Course Requirements: 6 units

See “Diversity Requirement” in the University Catalog. Most courses taken to satisfy these requirements may also apply to General Education.

U.S. History, Constitution, and American Ideals: 6 units

See “U.S. History, Constitution, and American Ideals” under “Bachelor's Degree Requirements”. This requirement is normally fulfilled by completing HIST 130 and POLS 155 or approved equivalents. Courses used to satisfy this requirement do not apply to General Education.

Literacy Requirement:

See “Mathematics and Writing Requirements” in the University Catalog. Writing proficiency in the major is a graduation requirement and may be demonstrated through satisfactory completion of a course in your major which has been designated as the Writing Proficiency (WP) course for the semester in which you take the course. Students who earn below a C- are required to repeat the course and earn a C- or better to receive WP credit. See the Class Schedule for the designated WP courses for each semester. You must pass ENGL 130 (or its equivalent) with a C- or better before you may register for a WP course.

Electives Requirement:

To complete the total 120 units required for the bachelor’s degree, select additional elective courses from the total University offerings. Be especially careful to select sufficient upper-division courses in order to meet the university requirement of 40 upper division units. The required courses in this degree program include a minimum of 17 upper division units. The General Education Program requires an additional 9 upper division units. Select additional upper division elective units as needed from the total University offerings. You should consult with an advisor regarding the selection of courses which will provide breadth to your University experience and possibly apply to a supportive second major or minor. For those pursuing a career in teaching, suggested elective courses include those required by the teaching credential programs at CSUC; contact the School of Education for information on specific required courses.

Grading Requirement:

All courses taken to fulfill major course requirements must be taken for a letter grade except those courses specified by the department as Credit/No Credit grading only.

Course Requirements for the Major: 45-46 units

Completion of the following courses, or their approved transfer equivalents, are required of all candidates for this degree.

Core Requirements: 29-32 units

6 courses required:

NSCI 141 Concepts in Physical Science 3.0  FS  
NSCI 142 Concepts in Life Science 3.0  FS  
Prerequisites: NSCI 141.  
NSCI 342 Concepts in Earth and Space Sciences 3.0  FS  
Prerequisites: NSCI 141  
NSCI 343 Concepts in Environmental Science 3.0  FS  
Prerequisites: NSCI 142  
NSCI 489A Internship in Science Teaching 1.0  FS  
Prerequisites: NSCI 141, 142. Concurrent enrollment in or prior completion of NSCI 342.  
PHYS 341 Advanced Inquiry into Physics 3.0  S  
Prerequisites: NSCI 141 or PHYS 202 A/B or PHYS 204 A/B or PHYS 100

1 course required:

NSCI 321 Scientific Inquiry 3.0  FS  WP  
Prerequisites: NSCI 141, 142.

1 course selected from:

CHEM 107 General Chemistry for Applied Sciences 4.0  FS  *  
Prerequisites: Intermediate Algebra  
CHEM 111 General Chemistry 4.0  FS  *
Prerequisites: Second-year high school algebra; one year high school chemistry. (One year of high school physics and one year of high school mathematics past Algebra II are recommended.)

1 course selected from:
GEOS 102 Physical Geology 3.0 FS *
Prerequisites: High school chemistry or physics is recommended; students with no previous science courses are advised to enroll in GEOS 101.
No college credit for those who have passed GEOS 101.
GEOS 105 Introduction to Astronomy 3.0 FS *
GEOS 265 Environment III: Atmosphere, Water and Soils 2.0 FA
Prerequisites: GEOS 106 (The Department of Geological and Environmental Sciences is in the process of changing this to “GEOS 166 or NSCI 343”)

1 course selected from:
BIOL 302 Evolution 3.0 SP *
Prerequisites: BIOL 101 or BIOL 108 or equivalent.
BIOL 318 Biology of Childhood 3.0 FS *
Prerequisites: one biological science course.
BIOL 334 Conservation ecology 3.0 FS *
Prerequisites: BIOL 101 or equivalent. (The Department of Biological Sciences is in the process of changing this to “NSCI 102 or equivalent.”)
BIOL 342 Field Biology 3.0 FS
Prerequisites: BIOL 101 (The Department of Biological Sciences is in the process of changing this to “NSCI 102, NSCI 142 or BIOL 108).

1 course selected from:
Biol 489 Internship in Biology: Leadership in Science Teaching 1.0-3.0 FS
CHEM 390 Special Problems in Science Education 1.0-3.0 FS
Prerequisites: CHEM 111, faculty permission.
CHEM 411 Chemistry Teaching Methods 3.0 SP
Prerequisites: CHEM 112, CHEM 270. CHEM 320 is recommended.
EDCI 448 Methods and Materials for Environmental Education 3.0 FS
Prerequisites: BIOL 342 or GEOS 130 or equivalent. (We are in the process of requesting that they add NSCI 343 to list.)
CHEM 341 Teaching Practicum in Geol and Envir Sciences 3.0 FS
Prerequisites: GEOS 102, GEOS 105, GEOS 203, GEOS 306, GEOS 321.
GEOS 489T Internship in Geoscience Teaching 3.0 FS
Prerequisites: GEOS 101 or 102, GEOS 105, GEOS 203.
PHYS 489T Internship in Physics Teaching 3.0 FS
Prerequisites: PHYS 300B and faculty permission.

1-5 units selected from any courses in the core or any option, which will not be used to meet other requirements in the major. Additional courses may be considered. Consult your major advisor.

Option Course Requirements: 11-13 units
The following courses, or their approved transfer equivalents, are required dependent upon the option chosen. Students must select one of the following options to complete the course requirements for the Natural Sciences major.

General Biology Option: 12 units
3 courses required
BIOL 151 Principles of Cellular and Molecular Biology 4.0 FS
Prerequisites: Recommend CHEM 111 or concurrent enrollment.
BIOL 152 Principles of Ecol, Evol, and Organismal Biology 4.0 SP
Prerequisites: BIOL 151 or faculty permission; recommend CHEM 112 or concurrent enrollment.
BIOL 153 Principles of Physiology and Development 4.0 FA
Prerequisites: BIOL 151; CHEM 112 or concurrent enrollment recommended.

Human Biology Option: 12 units
3 courses required
BIOL 103 Human Anatomy 4.0 FS *
BIOL 104 Human Physiology 4.0 FS *
BIOL 211 Allied Health Microbiology 4.0 FS
Prerequisites: A college course in biology and in general chemistry

Chemistry Option: 12 units
2 courses required
CHEM 112 General Chemistry 4.0 FS
Prerequisites: CHEM 111 with a grade of C- or higher.
CHEM 270 Organic Chemistry 4.0 FS
Prerequisites: CHEM 112.

4 units selected from:
CHEM 320 Quantitative Analysis 4.0 FS
Prerequisites: CHEM 112 with a grade of C- or higher.
CHEM 350 Introductory Biochemistry 3.0 FS
Prerequisites: CHEM 108.
CHEM 350L Introductory Biochemistry Laboratory 1.0 FS
Prerequisites: Concurrent enrollment in or prior completion of CHEM 350.
CHEM 370 Organic Chemistry 3.0 FS
Prerequisites: CHEM 270 with a grade of C- or higher.
CHEM 370L Organic Chemistry Laboratory 1.0 FS
Prerequisites: Concurrent enrollment in or prior completion of CHEM 370.

Environmental Science Option: 11 units
4 courses required
GEOS 300 Earth System Science 3.0 FA
Prerequisites: ENGL 130 (or its equivalent) with a grade of C- or higher; CHEM 107 or 111; PHYS 202A, PHYS 202B or PHYS 204A, PHYS 204B or PHYS 204C (The Department of Geological and Environmental Sciences is in the process of changing adding NSCI 141 and PHYS 341 to the list of physics courses that could satisfy this prerequisite requirement).
GEOS 365 Environment IV: Envir Science Applications 2.0 SP
Prerequisites: GEOS 265 or faculty permission.
GEOS 370 Energy in the Human Environment 3.0 SP *
Prerequisites: One course from Breadth Area B1.
GEOS 460 Water Resources Management 3.0 SP
Prerequisites: Upper-division standing; GEOS 330 or GEOS 380 (The Department of Geological and Environmental Sciences is in the process of adding "or NSCI 343" to this list.)

Geology Option: 12-13 units
3 courses required
GEOS 203 Principles of Historical Geology 3.0 FA
Prerequisites: GEOS 101 or GEOS 102.
GEOS 306 Mineralogy and Petrology 4.0 FA
Prerequisites: GEOS 101 or GEOS 102.
GEOS 307 Stratigraphy 3.0 FA
Prerequisites: GEOS 203 and GEOS 306 (both may be taken concurrently), or faculty permission.

1 course required
GEOS 303 Invertebrate Paleontology 3.0 SP
Prerequisites: GEOS 203 or course in biology.
GEOS 325 Geology of California 3.0 F2
Prerequisites: GEOS 101 or GEOS 102 or consent of instructor.
GEOS 360 Field Methods 2.0 SP

Physical Science Option: 12 units
2 courses required
PHYS 202A General Physics 4.0 FS *
Prerequisites: High school physics or faculty permission. High school trigonometry and second-year high school algebra or equivalent (MATH 051 and MATH 118 at CSU, Chico).
PHYS 202B General Physics 4.0 FS
Prerequisites: PHYS 202A

1 course required
CHEM 108 Organic Chemistry for Applied Sciences 4.0 FS
Prerequisites: CHEM 107 or 111 or equivalent.
CHEM 112 General Chemistry 4.0 FS
Prerequisites: CHEM 111 with a grade of C- or higher.

Electives Requirement:

To complete the total units required for the bachelor's degree, select additional elective courses from the total University offerings. You should consult with an advisor regarding the selection of courses which will provide breadth to your University experience and possibly apply to a supportive second major or minor. Because the middle school science curriculum often includes a unit on health, students pursuing a career in middle school science teaching may wish to minor in Health Science.
Conceptual Abstract
Bachelor of Arts in Natural Sciences
Concentration: Science and Environmental Literacy

College of Natural Sciences
Department of Science Education
California State University, Chico
November 2008

The Department of Science Education at California State University, Chico is committed to fostering scientific and environmental literacy and applying scientific and environmental knowledge to solving social and economic problems, especially in the North State region. To achieve these broad-based goals we wish to begin offering the Bachelor of Arts degree in Natural Sciences. We anticipate the program will serve the needs of many students whose interests span the natural sciences, and who wish to apply scientific knowledge, especially to the pressing needs of our diverse but largely rural service area.

Recognizing the range of the complex social problems we face (e.g., global warming, air and water pollution, the energy crisis, food shortages), we believe that these issues can be resolved only through the application of sound scientific knowledge. Further, we believe that universities such as ours can no longer afford to offer science degree programs exclusively to future scientists. We need policy makers, government officials, environmental advocates, business leaders, journalists, science writers, teachers, and community organizers with a strong interdisciplinary science background. Rather than a specialized science degree within a single academic discipline, these professionals are best served by a broad, liberal background across all of the natural sciences emphasizing conceptual understanding of fundamental concepts, critical thinking and problem-solving skills.

One important audience served by this program are future middle school science teachers. According to the 2007 report, Critical Path Analysis of California’s Science and Mathematics Teacher Preparation System, fewer than half of middle school science teachers hold a single-subject science credential (see graph below). Although a multiple-subject credential technically qualifies individuals to teach middle school science, this credential requires minimal science preparation and fails to qualify candidates for the “highly qualified” status they require.

In August, 2008, the California Commission on Teacher Credentialing (CCTC) approved a new Foundational-Level General Science authorization for a single subject credential. Holders of this credential will be authorized to teach the content area of general or introductory science in grades K–12. Our proposed Bachelor of Arts Degree in Natural Sciences will be an ideal program for students pursuing this credential, and a recent poll of those enrolled in our physical science course for Liberal Studies students indicated that over half would be interested in pursuing a second major that prepares them to teach science.
In contrast to existing programs at CSU Chico, the B.A. will require 40 units of science spread across four academic disciplines (biology, chemistry, geology and physics). For students who intend to teach general science, we will offer a “blended” professional program in collaboration with the CSU Chico School of Education which will enable students to complete all degree and certification requirements within 5 years.

All of the courses and faculty required to implement this degree program are currently in place within the Department of Science Education and other departments within the College of Natural Sciences. We anticipate minimal additional costs associated with it.

In summary, this new program promises to educate a new cadre of knowledge professionals in the natural sciences and most directly addresses Strategic Plan item #4: Believing in the value of service to others, we will continue to serve the educational, cultural, and economic needs of Northern California.


2 California Commission on Teacher Credentialing, Subject Matter Programs Approved Under the Current Commission’s Standards - CSU System, Showing All Schools. Available at http://134.186.81.79/fmi/xsl/CTC_NewSubject/AllSubjects.xsl


Proposed Amendments to 5 California Code of Regulations §80004 Pertaining to the Single Subject Teaching Credential Authorization, presented by the Credentialing and Certificated Assignments Committee of the California Commission on Teacher Credentialing for the June 2008 meeting. Available at http://www.ctc.ca.gov/commission/agendas/2008-06/2008-06-5A.pdf