UNIVERSITY OF WASHINGTON

OFFICE OF THE PRESIDENT

February 26, 2013

Dean Robert C. Stacey
College of Arts and Sciences
Box 353765

Dear Bob:

Based upon the recommendation of its Subcommittee on Admissions and Programs, the Faculty Council on Academic Standards has recommended approval of a Bachelor of Arts degree in Integrated Sciences. A copy of the approval is attached.

I am writing to inform you that the College of Arts and Sciences is authorized to specify these requirements beginning autumn quarter 2013.

The new requirements should be incorporated in printed statements and in individual department websites as soon as possible. The *General Catalog* website will be updated accordingly by the Registrar's Office.

Sincerely yours,

Michael K. Young
President

Enclosure

cc: Dr. Ron Irving (with enclosure)
Mr. Robert Corbett (with enclosure)
Dr. Deborah H. Wiegand (with enclosure)
Ms. Virjean Edwards (with enclosure INTSCI-20110401R)

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UNIVERSITY OF WASHINGTON

CREATING AND CHANGING UNDERGRADUATE ACADEMIC PROGRAMS

OFFICE USE ONLY
Control # INTSCI-20110401 R
Revised 10/2/12

After college/school/campus review, send a signed original and 8 copies to the Curriculum Office/FCAS, Box 355850.
For information about when and how to use this form: http://depts.washington.edu/uwcr/1503instructions.pdf

College/Campus Seattle	**Department/Unit** College of Arts and Sciences	**Date** April 1, 2011

New Programs

- ☐ Leading to a Bachelor of __ in _____ degree.
- ☒ Leading to a Bachelor of Arts degree with a major in Integrated Sciences.
- ☐ Leading to a _____ Option within the existing major in _____.
- ☐ Leading to a minor in _____

Changes to Existing Programs

- ☐ New Admission Requirements for the Major in _____ within the Bachelor of _____.
- ☐ Revised Admission Requirements for the Major in _____ within the Bachelor of _____.
- ☐ Revised Program Requirements for the Major in _____ within the Bachelor of _____.
- ☐ Revised Requirements for the Option in _____within the major in _____.
- ☐ Revised Requirements for the Minor in _____.

Other Changes

- ☐ Change name of program from _____ to _____.
- ☐ New or Revised Continuation Policy for _____.
- ☐ Eliminate program in _____.

Proposed Effective Date: **Quarter:** ☒ Autumn ☐ Winter ☐ Spring ☐ Summer **Year:** 20 11 (13)

Contact Person: Ron Irving, Director	Phone: 3-1165	Email: rsi@uw.edu	Box: 354350

EXPLANATION OF AND RATIONALE FOR PROPOSED CHANGE

For new program, please include any relevant supporting documentation such as student learning outcomes, projected enrollments, letters of support and departmental handouts. (*Use additional pages if necessary*).

See attached.

OTHER DEPARTMENTS AFFECTED

List all departments/units/ or co-accredited programs affected by your new program or changes to your existing program and acquire the signature of the chair/director of each department/unit listed. Attach additional page(s) if necessary. *See online instructions.

Department/Unit:	Chair/Program Director:	Date:
Department/Unit:	Chair/Program Director	Date:

CATALOG COPY

Catalog Copy as currently written. Include only sections/paragraphs that would be changed if your request is approved. Please cross out or otherwise highlight any deletions.

PROPOSED CATALOG COPY

Reflecting requested changes (Include exact wording as you wish it to be shown in the printed catalog. Please underline or otherwise highlight any additions. If needed, attach a separate, expanded version of the changes that might appear in department publications).
Please note: all copy will be edited to reflect uniform style in the General Catalog.

See attached.

APPROVALS

Chair/Program Director:	Date: 3/3/11
College/School/Campus Curriculum Committee:	Date: 4/1/11
Dean/Vice Chancellor:	Date: 4/1/11
Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair:	Date: 11/30/12

POST TRI-CAMPUS APPROVAL (when needed)

Faculty Council on Academic Standards/ General Faculty Organization/Faculty Assembly Chair:	Date: 1/25/13

Bachelor of Arts degree in Integrated Sciences:

Admission Requirements

Admission is competitive and is based on cumulative GPA and grades in Basic Science and Mathematics courses, Basic Science or Mathematics instructor recommendation, personal statement, and demonstrated interest in science or science education.

Students must achieve a minimum cumulative GPA of 2.50 and a minimum grade of 2.0 in all Basic Science and Mathematics applied to the major, but achieving the grade minimums does not guarantee admission to the major.

Applicants need to have completed a minimum of 35-45 credits from the Basic Science and Mathematics courses (see program requirements), including a minimum of 15[i] credits in each of two fields and a minimum of 15 credits combined from the remaining three fields.

Applications, including all supporting materials must be submitted by April 5 for Autumn Quarter and January 5 for Spring Quarter.

Graduation Requirements

96-108 credits, as follows:

1) Basic Science and Mathematics (50-60 credits): to include 15[i] credits from two disciplines below and a minimum of 10 credits from each of the other three with a minimum cumulative GPA of 2.00 in each discipline:

    Biology: BIOL 180 and BIOL 200; BIOL 220
    Chemistry: one of the following sequences
        a. CHEM 142 and CHEM 152; CHEM 162
        b. CHEM 145 and CHEM 155[i]; CHEM 165
    Earth and Space Sciences: ESS 211 and ESS 213, ESS 212
    Mathematics: one of the following sequences
        a. MATH 124 and MATH 125; MATH 126 or STAT 311
        b. MATH 134 and MATH 135[i], MATH 136
        c. Q SCI 291 and Q SCI 292; Q SCI 381 (only for students pursuing Aquatic and Fishery Sciences and Environmental Sciences and Forest Resources disciplinary tracks; recommended for these tracks).
    Physics: one of the following sequences
        a. PHYS 114/PHYS 117 and PHYS 115/PHYS 118; PHYS 116/PHYS 119
        b. PHYS 121 and PHYS 122; PHYS 123
        c. PHYS 210 and PHYS 211; PHYS 212

Notes:

i. *The 10 credit Honors General Chemistry sequence, CHEM 145 and CHEM 155, and the Honors Accelerated Calculus sequence, MATH 134 and MATH 135, may be substituted for the 15 credit non-honors sequences.*

2) Disciplinary Tracks (18-20 credits): including a minimum of two courses taken in residence at the University of Washington and a minimum cumulative 2.00 GPA.

Aquatic and Fishery Sciences (minimum of 18 credits): minimum of 18 credits from FISH 310, FISH 311, FISH 312, FISH 323, FISH 324, FISH 330, and FISH 473. Lab classes may be taken with permission of advisor.

Astronomy (minimum of 18 credits): ASTR 321; ASTR 322; ASTR 323; minimum of 9 credits of approved astronomy and physics courses.

Atmospheric Sciences (minimum of 18 credits): ATM S 301; minimum of 13 credits from ATM S 321; ATM S 340; ATM S 341; ATM S 358; ATM S 370, and ATM S 431.

Biology (minimum of 18 credits): Two courses from BIOL 350, BIOL 354, BIOL 355, and BIOL 356; minimum of 12 credits of approved upper-division biology courses.

Chemistry (minimum of 19-20 credits): either CHEM 237, CHEM 238, and CHEM 239 or CHEM 335, CHEM 336, and CHEM 337; minimum of 8-9 credits from CHEM 165 or CHEM 312; CHEM 241 or CHEM 346; CHEM 242 or CHEM 347; CHEM 436, CHEM 452, CHEM 453, CHEM 456, BIOC 405, and BIOC 406.

Earth and Space Sciences (minimum of 18 credits): Two courses from ESS 311, ESS 312, ESS 313, ESS 314, ESS 315; minimum of 8 additional credits from above list or approved 400-level courses.

Environmental and Forest Sciences (minimum of 18 credits): ESRM 315 or ESRM 323; ESRM 350; ESRM 403 or ESRM 470; remaining credits from ESRM 311; ESRM 362, ESRM 415, ESRM 425, ESRM 441, ESRM 465, ESRM 472, or ESRM 473.

Oceanography (minimum of 18 credits): OCEAN 200; OCEAN 201; OCEAN 210; one of OCEAN 400, OCEAN 410, OCEAN 420, or OCEAN 430; minimum of 3 credits of approved 300- or 400-level courses; minimum of 3 credits of approved 400-level courses.

Physics (minimum 18 credits): PHYS 224; PHYS 231; PHYS 248; PHYS 334; two of PHYS 335, PHYS 431, PHYS 433, and PHYS 434 or one of these courses and each of PHYS 407, PHYS 408, and PHYS 409.

3) Integrated Sciences Core (13 credits): minimum cumulative 2.00 GPA in INTSCI 301; INTSCI 401; INTSCI 402; and INTSCI 403.

4) Integrated Sciences Capstone (minimum of 15 credits): minimum cumulative 2.00 GPA in INTSCI 491; INTSCI 492; and INTSCI 493; minimum of 6 credits of ASTR 499, ATM S 492, BIOL 499; CHEM 499, ESRM 499, ESS 499, FISH 499, OCEAN 499, PHYS 499, or other approved undergraduate research course.

Bachelor of Arts in Integrated Sciences
Degree Proposal
December 6, 2012

Table of Contents

I. Overview

The College of Arts and Sciences and the College of the Environment at the University of Washington propose to create a new Bachelor of Arts degree in Integrated Sciences. This degree is intended to meet the needs of undergraduates planning careers in secondary science teaching, informal science education at museums or other science institutions, science writing, or science policy and technology law, as well as students whose intellectual interests incline them toward a rigorous program of study across all the sciences. Such students require knowledge of a range of sciences, an in-depth understanding of what the process of science is, an appreciation of the ethical and social contexts in which science is done, and the ability to approach a scientific problem by drawing from and integrating knowledge from a variety of scientific fields. This contrasts with the more narrowly focused program typical for students majoring in a single discipline in preparation for graduate study and research in that field.

The two distinctive features of the Integrated Sciences program are its emphasis on an intensive research experience and its expectation that students will come to understand the historical, social, ethical, and epistemological dimensions of science. They will not only learn scientific truths, but also come to understand how scientific truth is established and participate in the process. Moreover, by studying a range of sciences, they will be better positioned to engage in work that crosses disciplinary boundaries or is part of new scientific fields.

This is a degree in science, not in science education or science writing or science policy. Graduates will have the science background for such careers, but further professional study specific to those careers will be necessary. A prospective science teacher, for instance, upon receiving the BA in Integrated Sciences, might next enroll in UW's Secondary Teacher Education Program for a Master's in Teaching plus science teaching certification. Perhaps also worth emphasizing is that students planning on careers in secondary science teaching within a specific discipline, such as physics or biology, may be better advised to major in that discipline itself rather than Integrated Sciences. There is no single best path; Integrated Sciences will be a better option for some, but by no means all.

The proposed degree program will be rigorous, drawing from courses in mathematics and the biological and physical sciences plus newly designed integrative courses and a research experience. There are four components:

1. Basic Science and Mathematics (60 credits). Students will take two or three quarters of courses from the standard year-long introductory sequences in mathematics, physics, chemistry, biology, and earth and space sciences that are offered to majors in those fields. These courses collectively will give students extensive laboratory experience and opportunities to observe various fields joining together to address common problems. They provide the essential foundation for all that follows.

2. Disciplinary Track (18 credits minimum). An integrated science student will select one field of specialization from among Aquatic and Fishery Sciences, Astronomy, Atmospheric Sciences, Biology, Chemistry, Earth and Space Sciences, Environmental and Forest Sciences, Oceanography, and Physics. In that field, the student will take at least 18 credits of course work from an approved list of courses designed for the discipline's

majors. A list of recommended programs of study and advice from program counselors will ensure coherence in the course selection. Through this component, the student will acquire an in-depth understanding of the problems and techniques typical of the given discipline to a level sufficient to participate in research in that discipline or allied ones.

3. Integrated Sciences Core (13 credits). Four new courses have been designed for the degree program. These courses will bring the majors together as a cohort and give them a rich perspective on the scientific process and its societal significance.

   i. IntSci 301, Integrated Sciences Seminar (1 credit). The seminar will introduce students to scientists or science educators who are actively engaged in careers that require an integrative science perspective. The focus will vary from quarter to quarter, with sessions devoted to educational issues, law, policy, and similar topics. In Spring 2011, the seminar was run on a pilot basis with an education focus. Classroom guests included middle school science teachers, high school science teachers, science educators from the Pacific Science Center in Seattle, curators and staff from the Burke Museum of History and Culture on the UW campus, science writers, and more. In addition, each student visited a museum, school, or other institution to explore its work in more detail.

   ii. IntSci 401, Integrated Sciences Practicum (2 credits). The practicum will provide students with the opportunity to explore professional opportunities in formal or informal science education, science writing, science policy, or other areas that require an integrated science perspective. Each student will prepare a one-page proposal of a 50-hour practicum experience, in consultation with the program advisor and a practicum supervisor. Approval by the program director is required. Examples include weekly visits to a science classroom, volunteer work at a science or natural history museum, or participation in a science education partnership with a local, regional, or national science research institution or agency. The student will prepare a two-to-three page written report on the experience, identifying the role played by a broad science background and insights gained on the role of science in society. In addition, the student will make a ten-minute oral presentation to the students of an IntSci 301 class.

   iii. IntSci 402, Nature of Science (5 credits). This course will be co-taught by a scientist and a philosopher or historian, with topics to include the underlying principles of science, methodologies of science, the differences between invention and discovery, science ethics, science versus other ways of knowing, and the communication of science. Typically, a given scientific theory of historic importance, such as the theory of continental drift, will serve as source material, with students exploring the scientific issues themselves as well as questions regarding initial resistance to the theory and its ultimate acceptance.

   iv. IntSci 403, Science in Context (5 credits). This course will be co-taught by a scientist and a social scientist with an interest in science from an ethical or societal perspective, and will focus on a case study examination of how science operates

within broad social, political, and ethical contexts. The course will consider the growth of multidisciplinary and interdisciplinary research, the societal impact of scientific results and developed technologies, the political environment surrounding scientific practice, ethical responsibilities of scientists, the acceptability of censorship, the complex mechanisms for funding scientific research, and the power inherent in claims to knowledge. Topics for case study may include global climate change, evolution, and stem cell research.

These courses complement the disciplinary track courses that students will take at the same time, both in providing students an opportunity to examine scientific issues outside the given track and in giving the students the tools to make better sense of the scientific knowledge they are studying in their disciplines and how that knowledge was developed. This is an important feature of the program's integrative experience.

4. Capstone Research Experience (15 credits). This is the heart of the program. Each student will participate in scientific research with a faculty member in a lab or in the field for 6 credits. Students may opt to work with faculty members from within their chosen disciplinary track departments, but research experiences that lie outside the track or that integrate several fields will be encouraged. In parallel, students will enroll in a new sequence of integrated science seminars:

   i. IntSci 491, Introduction to Research (2 credits). This course will prepare students for an intensive scientific research project. It will include discussions of what constitutes scientific research, development of a research proposal in conjunction with research mentor and the course instructor, and presentation of the research proposal.

   ii. IntSci 492, Reflections on Research (2 credits, taken twice). Students will take this course while participating in an ongoing research project. It will center on discussions of student research, data collection, and data analysis. The format will include formal and informal discussions, short papers and oral presentations.

   iii. IntSci 493, Communicating Research (3 credits). Students will take this course near the end of or after completing their research projects. They will prepare their research findings for oral and/or written communication, working closely with their research mentor and instructor to prepare class and symposium presentations, research papers, or other forms of publication.

The combination of the research itself and the seminar series is crucial to the anticipated success of the capstone experience. Through the seminars, students will acquire a deeper understanding of the research process in which they are participating. Moreover, by meeting with others in their cohort, they will obtain a broader perspective on the challenges of doing and communicating research while simultaneously getting insight into the nature of scientific research in other fields.

A student who has successfully completed this degree will have gained abstract scientific knowledge in multiple fields, learned how that knowledge is integrated to solve problems that cut across disciplines, discovered how practicing scientists carry out research investigations in the lab or the field, and in addition studied and reflected on the scientific enterprise itself. These opportunities for reflection, through the new courses on nature of science and science in context and through the capstone seminar series, give the degree its distinctive character. The deeper knowledge that graduates will acquire about what it means to do science, how scientific truths are evaluated, and what the ethical and social implications of this process are will equip them to be outstanding educators, writers, analysts, or simply citizens.

Admission to the Integrated Sciences program will be competitive, in anticipation that eligible applicants will exceed the space available. An initial cap on program size will be set at 50 majors so that the demands on the program can be met with the available resources. Given sufficiently large demand and the provision of additional resources, this cap may later be increased to 100.

II. Program Regulations

Degree Program Admission Requirements: The Integrated Sciences program is a competitive major, with admission offered to upper division applicants for Autumn and Spring Quarters. The following requirements apply:

1. A minimum cumulative 2.50 GPA for all college coursework.
2. A minimum cumulative 2.50 GPA for all required Basic Science and Mathematics courses, as listed below.
3. A minimum grade of 2.0 in each Basic Science and Mathematics course.
4. Admission will be based on evaluation of four factors:
    a. overall scholastic record;
    b. grades in pre-application courses, described below;
    c. written communication skills; and
    d. evidence of research interest or skills and promise of achievement in a science or science education career.

Applicants must present a minimum of 45 academic credits, at the time of application, from the Basic Science and Mathematics courses listed in Section III, with a minimum of 15 credits in each of two fields and a minimum of 15 credits combined from the remaining three fields. They must also provide a non-binding statement of preference for one of the Integrated Sciences disciplinary tracks, a personal statement explaining their interest in the program, a letter of support from an instructor in a basic mathematics or science course, and a description of any relevant experiences beyond course work. An Integrated Sciences application, together with all supporting materials, must be on file by April 5 for Autumn Quarter admission or January 5 for Spring Quarter admission. Records of all coursework completed by the deadline must be submitted at the time of application. Applications will be reviewed

by the Integrated Sciences Steering Committee's Admissions Subcommittee, with judging based on applicant course grades, instructor recommendation, personal statement, and demonstrated interest in science or science education.

Degree Program Grade Requirement: A minimum cumulative 2.0 GPA is required in each Basic Science and Mathematics sequence, in the Integrated Sciences core courses, in the Integrated Sciences capstone courses, and in the courses applied to meet the disciplinary track requirements. The degree program is designed to serve students with a variety of interests, from secondary science teaching and informal science education in museums to science writing and science policy. In each of these arenas, a future professional must have a solid grasp of the science that underlies his or her work. The grade standard has been established in order to produce graduates who have demonstrated a strong scientific background. Requests to waive the requirement in special cases will be considered by the program director and steering committee.

Continuation Policy: The University has general regulations governing scholastic eligibility for continuance. The Integrated Sciences program has adopted additional requirements in order to make the best use of the resources available and to provide reasonable assurance of academic success. The following criteria and procedures are applied to all undergraduate students for determining continuance in the program.

1. Each Integrated Sciences major must create an academic plan with an Integrated Sciences academic advisor. The academic plan lays out the courses a student takes quarter by quarter to ensure timely completion of degree requirements. A copy of the approved academic plan is kept on file at the Integrated Sciences offices

2. Each major must select a disciplinary track on being admitted to the Integrated Sciences degree program or at the start of junior year, whichever is later. A student wishing to change disciplinary tracks must consult with an Integrated Sciences academic advisor to obtain approval of a revised and updated academic plan.

3. When withdrawing from a course required for the degree, a student must communicate with an Integrated Sciences academic advisor to obtain approval of a revised and updated academic plan.

4. A student must review his or her academic plan with an Integrated Sciences academic advisor for approval at least once per academic year.

5. Student records are reviewed quarterly. If a student's performance fails to meet the standards outlined above, the student is issued a one-time warning letter. The letter details the way in which the criteria are not being met and suggests actions the student can take. If a student fails to meet the standards outlined above in any subsequent quarter, the student is placed on probation. The student is notified in writing of the probationary status and what must be done to remove it. If a student on probation fails to meet the criteria listed above, the student is notified in writing and dropped from the major.

The Integrated Sciences program recognizes that inequities can result from any continuation policy. If students are placed on probation or dismissed and believe their record has been

misunderstood, they may request reconsideration of the probation or dismissal by writing a letter to the Integrated Sciences Director. The letter should include any additional supporting or relevant material. The Director will review all available information and then decide whether or not academic probation should be continued for another quarter or whether the dismissal was appropriate and valid. Any student appeal must be made within 30 days of the notification of placement on probation or dismissal. The Director responds to the student appeal within 30 days.

III. The Program

BASIC SCIENCE AND MATHEMATICS COURSES [60 credits, to include 15 credits from each of two categories below and 10 credits from each of the other three.]

10-15 credits	BIOL 180, 200 (required) BIOL 220 (optional)
10-15 credits	CHEM 142, 152 or CHEM 145, 155 (required) CHEM 162 (optional)
10-15 credits	ESS 211, 213 (required) ESS 212 (optional)
10-15 credits	MATH 124, 125 or MATH 134, 135 MATH 126 or Math 136 (optional) STAT 311, Q SCI 381, or equivalent (optional)
10-15 credits	PHYS 114/117, 115/118; PHYS 121, 122; or PHYS 210, 211 (required) PHYS 116/119; PHYS 123; or PHYS 212 (optional)

Notes: (i) The Honors General Chemistry sequence CHEM 145-155, although only 10 credits, may be substituted for 15 credits of CHEM 142-152-162.

(ii) The Honors Accelerated Calculus sequence MATH 134-135, although only 10 credits, may be substituted for 15 credits of MATH 124-125-126.

(iii) Q Sci 291, 292 may be substituted for Math 124, 125 (and is recommended) for students choosing the Aquatic and Fishery Sciences or Environmental and Forest Sciences disciplinary track.

DISCIPLINARY TRACK COURSES

Aquatic and Fishery Sciences Track (18 credits minimum)
18 credits from the following courses: Fish 310 (3 cr.), Fish 311 (3 cr), Fish 312 (3 cr.), Fish 323 (5 cr.), Fish 324 (3 cr.), Fish 330 (5 cr.), Fish 473 (3 cr.). Lab classes can be taken with permission.

Astronomy Track (18 credits minimum)

ASTR 321, 322, 323 (3 cr. each) and 9 credits of approved astronomy or physics courses.

Atmospheric Sciences Track (18 credits minimum)

ATM S 301 (5 cr.); an additional 13 credits from ATM S 321, 340, 341, 358, 431 (3 cr. each), or 370 (5 cr.).

Biology Track (18 credits minimum)

Two courses selected from BIOL 350, 354, 355, 356 (3 cr. each); an additional 12 credits from approved upper level (3xx or 4xx) course work in biological sciences.

Chemistry Track (19-20 credits minimum)
CHEM 237, 238, 239 or CHEM 335, 336, 337 (11 credits); remaining credits from CHEM 165 (5 cr.) or 312; CHEM 241 or 346, CHEM 242 or 347, CHEM 436, 452, 453, 455, 456; BIOC 405, 406 (all 3 cr.).

Earth & Space Sciences Track (18 credits minimum)

Two courses selected from ESS 311, 312, 313, 314, 315 (5 cr. each); 8 additional credits from this same list or from a list of approved 400-level courses.

Environmental and Forest Sciences Track (18 credits minimum)
ESRM 315 (5 cr.) or ESRM 323 (5 cr.); ESRM 350 (5 cr.); ESRM 403 (4 cr.) or ESRM 470 (5 cr.); remaining credits from ESRM 311, 362, 415, 425, 441, 472, 473 (5 cr. each), or ESRM 465 (3 cr.).

Oceanography Track (18 credits minimum)

OCEAN 200 (3 cr.), 201 (2 cr.), and 210 (3 cr.); one of OCEAN 400, 410, 420, 430 (4 cr. each); 3 elective credits at the 300- or 400-level and 3 elective credits at the 400-level from an approved list of courses.

Physics Track (18 credits minimum)

PHYS 224, 231, 248, 334 (3 cr. each) and two of PHYS 335, 431, 433, 434 (3 cr. each); or one course from above list plus PHYS 407, 408, 409 (5 cr. each); or other approved combinations.

Notes: (i) Students must complete at least two disciplinary track courses at the University of Washington.

(ii) Students choosing the Biology, Chemistry, or Earth and Space Sciences Track must take 15 credits in that discipline as part of the Basic Science and Mathematics course requirement.

(iii) Students choosing the Astronomy, Atmospheric Sciences, or Physics Track must take MATH 126 and PHYS 121, 122, 123 as part of the Basic Science and Mathematics course requirement.

(iv) Students choosing the Aquatic and Fishery Sciences, Environmental and Forest Sciences, or Oceanography track should consult with the program advisor regarding the selection of Basic Science and Mathematics courses as well as a coherent sequence of upper division electives.

INTEGRATED SCIENCES CORE COURSES [13 credits]

1 credit	INTSCI 301, Integrated Sciences Seminar
2 credits	INTSCI 401, Integrated Sciences Practicum
5 credits	INTSCI 402, Nature of Science
5 credits	INTSCI 403, Science in Context

INTEGRATED SCIENCES CAPSTONE COURSES [15 credits]

2 credits	INTSCI 491, Introduction to Research
4 credits	INTSCI 492, Reflections on Research (to be taken twice)
3 credits	INTSCI 493, Communicating Research
6 credits	ASTR 499, ATM S 492, BIOL 499, CHEM 499, ESRM 499, ESS 499, FISH 499, OCEAN 499, PHYS 499, or other approved undergraduate research course, C/NC

IV. Description of New Integrated Sciences Core Courses

INTSCI 301 Integrated Sciences Seminar (1 credit) The seminar will include participation in formal and informal science education settings with subsequent reporting; presentations by science educators; reading and discussing research articles on science education and communication.

INTSCI 401 Integrated Sciences Practicum (2 credits) A field experience with a scientist, science educator, or other professional using science in an integrated way. Observations and volunteer work under the professional's guidance, a written report on the experience, and an oral presentation to the students in INTSCI 301.

INTSCI 402 Nature of Science (5 credits) A case study examination of scientific methods and elements of scientific practice including observation, data, statistics, interpretations, hypothesis, theory, and law. How does science change? How do data support theories? How are theories verified, falsified, or modified?

INTSCI 403 Science in Context (5 credits) A case study examination of how science operates within broad social, political and ethical contexts. The growth of multidisciplinary and interdisciplinary research, societal impacts, ethical responsibilities, censorship, complex mechanisms of funding, and the power inherent in claims to knowledge are considered.

INTSCI 491 Introduction to Research (2 credits) Preparation for an intensive "hands-on" science experience. Discussion of what constitutes scientific research; development of a research proposition; meetings with potential research supervisors; signed agreement with supervisor and capstone instructor on scope and details of research project. Work that crosses disciplinary boundaries is encouraged.

INTSCI 492 Reflections on Research (2 credits, max 6) Reflections through discussion, short papers, and oral presentations on an on-going science research experience, with emphasis on the challenges and dilemmas that arise in data collection and analysis. Concurrent registration required in a departmental research course.

INTSCI 493 Communicating Research (3 credits) Prepare oral and written presentations of research, under the guidance of the capstone instructor. Presentation on research in class and in another venue, such as a scientific meeting or an on-campus research symposium.

V. Model Student Programs

A student's selection of disciplinary track courses must be coherent, with courses building on previous ones in an appropriate way. As described in the Continuation Policy, each student is required to have an approved academic plan. For each discipline, sample model programs will be available as a guide. The academic advisor will work closely with the program director and steering committee in reviewing proposed plans.

On the following pages are nine model programs, each displaying a set of courses a student might take to meet the Integrated Sciences degree requirements in a particular disciplinary track. The models assume that the student comes to the university as a freshman and stays on schedule to graduate in four years. Adjustments would be made for transfer students or students deciding to pursue the Integrated Sciences major at a later point in their studies.

Model Aquatic and Fishery Sciences Program 19 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Q Sci 291	Q Sci 292	Q Sci 381
Chem 142	Chem 152	
Phys 114/117	Phys 115/118	
Second Year		
Biol 180	Biol 200	Biol 220
IntSci 301		
Fish 310 (Bio Shellfish) (5 cr.)	Fish 311 (Bio Fishes) (3 cr.)	Fish 312 (Fisheries Ecol) (3 cr.)
Third Year		
IntSci 401	IntSci 402	IntSci 403
ESS 211		ESS 213
Fish 323 (Cons/Mgmt) (5 cr.)	Fish 324 (Aquatic physio) (3 cr.)	
IntSci 491		Fish 499
Fourth Year		
Fish 499	Fish 499	Fish 499
IntSci 492	IntSci 492	IntSci 493

Model Astronomy Program 18 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	Math 126
Phys 121	Phys 122	Phys 123
Chem 142	Chem 152	
Second Year		
Biol 180	Biol 200	
IntSci 301		
Phys 224 (Thermal) (3 cr.)		
Astr 321 (Solar System) (3 cr.)	Astr 322 (Stellar) (3 cr.)	Astr 323 (Extragalactic) (3 cr.)
Third Year		
IntSci 401	IntSci 402	IntSci 403
ESS 211		ESS 213
Astr 421 (Stellar theory) (3 cr.)	Astro 300 (Programming) (2cr.)	Astr 500 (Teaching meth.) (1 cr.)
IntSci 491		Astr 499
Fourth Year		
Astr 499	Astr 499	Astr 499
IntSci 492	IntSci 492	IntSci 493

Model At. Sci. Program 19 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	Math 126
Phys 121	Phys 122	Phys 123
Chem 142	Chem 152	
Second Year		
ESS 211		ESS 213
Biol 180	Biol 200	
IntSci 301		
Third Year		
IntSci 401	IntSci 402	IntSci 403
Atm S 301 (Intro to At. Sci.) (5 cr.)	Atm S 370 (Atmos. Struct.) (5 cr.)	Atm S 321 (Climate science) (3 cr.)
IntSci 491		Atm S 492
Fourth Year		
AtmS 431 (Bdry layer meteor) (3 cr.)	Atm S 340 (Thermo/Clouds) (3 cr.)	
Atm S 492	Atm S 492	Atm S 492
IntSci 492	IntSci 492	IntSci 493

Model Biology Program 19 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	
Chem 142	Chem 152	Chem 162
Phys 114/117	Phys 115/118	
Second Year		
Biol 180	Biol 200	Biol 220
ESS 211		ESS 213
IntSci 301		
Third Year		
IntSci 401	IntSci 402	IntSci 403
Biol 356 (Ecology) (3 cr.)	Biol 354 (Evol/Systematics) (3 cr.)	Biol 443 (Evol'n mammals) (5 cr.)
IntSci 491		Biol 499
Fourth Year		
Biol 472 (Comm. Ecology) (5 cr.)	Genome 361 (Genetics) (3 cr.)	
Biol 499	Biol 499	Biol 499
IntSci 492	IntSci 492	IntSci 493

Model Chemistry Program 20 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	Math 126
Chem 142	Chem 152	Chem 162
Phys 121	Phys 122	
Second Year		
Biol 180	Biol 200	
Chem 237 (Organic) (4 cr.)	Chem 238 (Organic) (4 cr.)	Chem 239 (Organic) (3 cr.)
	Chem 241 (Organic lab) (3 cr.)	Chem 242 (Organic lab) (3 cr.)
IntSci 301		
Third Year		
IntSci 401	IntSci 402	IntSci 403
ESS 211		ESS 213
Chem 312 (Inorganic) (3 cr.)		
IntSci 491		Chem 499
Fourth Year		
Chem 499	Chem 499	Chem 499
IntSci 492	IntSci 492	IntSci 493

Model ESS Program 19 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	Stat 311
Phys 121	Phys 122	
Chem 142	Chem 152	
Second Year		
Biol 180	Biol 200	
ESS 211	ESS 212	ESS 213
IntSci 301		
Third Year		
IntSci 401	IntSci 402	IntSci 403
	ESS 311 (Geomechanics) (5 cr.)	ESS 312 (Geochemistry) (5 cr.)
IntSci 491		ESS 499
Fourth Year		
ESS 437 (Mineralogy) (5 cr.)	ESS 462 (Volcanic processes) (4 cr.)	
ESS 499	ESS 499	ESS 499
IntSci 492	IntSci 492	IntSci 493

Model Environmental and Forest Sciences Program 19 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Q Sci 291	Q Sci 292	Q Sci 381
Chem 142	Chem 152	
Phys 114/117	Phys 115/118	
Second Year		
Biol 180	Biol 200	Biol 220
IntSci 301		
ESRM 350 (W'life Bio/Cons) (5)		ESRM 315 (Nat Res) (5 cr.)
Third Year		
IntSci 401	IntSci 402	IntSci 403
ESS 211		ESS 213
ESRM 403 (Develop World)(4 cr.)	ESRM 473 (N.A. Restoration) (5)	
IntSci 491		ESRM 499
Fourth Year		
ESRM 499	ESRM 499	ESRM 499
IntSci 492	IntSci 492	IntSci 493

Model Ocean Program Ocean circulation/Climate 18 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	Math 126
Phys 121	Phys 122	Phys 123
Chem 142	Chem 152	Ocean 200/201 (Intro) (3+2 cr.)
Second Year		
Biol 180	Biol 200	
Ocean 210 (Ocean circ.) (3 cr.)	Ocean 355 (Origin/evol/climate)(3 cr.)	
IntSci 301		
Third Year		
IntSci 401	IntSci 402	IntSci 403
ESS 211		ESS 213
	Ocean 420 (Phys. Proc.) (4 cr.)	Ocean 423 (Circ. & Clim.) (3 cr.)
	IntSci 491	
Fourth Year		
Ocean 499	Ocean 499	Ocean 499
IntSci 492	IntSci 492	IntSci 493

Model Physics Program 18 Disciplinary Track credits		
Autumn Quarter	**Winter Quarter**	**Spring Quarter**
First Year		
Math 124	Math 125	Math 126
Phys 121	Phys 122	Phys 123
Chem 142	Chem 152	
Second Year		
Biol 180	Biol 200	
Phys 224 (Thermal) (3 cr.)	Phys 231 (Experimental) (3 cr.)	Phys 248 (Modern phys) (3 cr.)
IntSci 301		
Third Year		
IntSci 401	IntSci 402	IntSci 403
ESS 211		ESS 213
	Phys 334 (Electrical circuits) (3 cr.)	Phys 335 (Electrical circuits) (3 cr.)
IntSci 491		Phys 499
Fourth Year		
	Phys 431 (Modern phys lab) (3 cr.)	
Phys 499	Phys 499	Phys 499
IntSci 492	IntSci 492	IntSci 493

VI. Governance

The Integrated Sciences program will be overseen by a director and a steering committee. The director will be a faculty member in the College of Arts and Sciences or the College of the Environment, appointed jointly by the deans of the two colleges for a three-year term with the option of re-appointment. In recognition of the director's effort, funds will be available for teaching reduction or summer salary, with details negotiated at the time of appointment. An associate director may also be appointed to assist in some of the duties.

The steering committee will consist of:

1. The director and associate director;

2. a faculty member from each disciplinary track unit, appointed by the director in consultation with the unit's chair or director;

3. a faculty member from a social sciences unit with expertise in the history, philosophy, or sociology of science, appointed by the director in consultation with the unit's chair or director;

4. a faculty or staff member from each college dean's office, appointed by the dean;

5. additional faculty or staff appointed by the director, after appropriate consultation, from units or organizations naturally allied with the degree program. Examples: a science education expert in the College of Education, a curator or educator from the Burke Museum of Natural History and Culture or the Pacific Science Center, a science teacher or science curriculum expert from a local school district, a science writer.

The director will be responsible for the program's budget and operations, and for supervising any personnel supported by program funds. In cases of personnel who are jointly funded by the Integrated Sciences program and another unit, the director will ensure good communication with the appropriate supervisors from the other unit on performance reviews and merit recommendations. The director is also responsible for oversight of the Integrated Sciences curriculum, consulting with collaborating units as needed on issues of course availability, course prerequisites, and disciplinary track requirements. The director will ensure that instructors are available each year for Integrated Sciences courses, working with chairs as needed on teaching buyout plans. In performing these duties, the director will keep the steering committee informed on program developments and seek its advice. The director will also work with the committee and program staff on admission of undergraduates to the program.

VII. Student Learning Outcomes

The Integrated Sciences degree will provide students with a strong background in science, experience in conducting scientific research, an understanding of the challenges of doing research, insight into how new scientific knowledge is created, and an appreciation of the societal context in which science is done. Specific learning outcomes have been developed as well as methods of assessing whether the outcomes have been achieved.

1. Basic Science and Mathematics:

   Outcome 1: Understanding of basic concepts in biology, chemistry, earth and space sciences, physics, and mathematics. *Assessment*: Course grades in core courses in these areas.

   Outcome 2: Experience with lab techniques in biology, chemistry, earth and space sciences, and physics. *Assessment*: Course grades in lab courses in these areas.

2. Scientific Discipline:

   Outcome 1: Grounding in the concepts of a scientific discipline. *Assessment*: Course grades in more advanced courses in the discipline.

   Outcome 2: In-depth understanding of the techniques of a scientific discipline. *Assessment*: Evaluation of capstone research work by capstone instructor and research supervisor.

3. Integrated Sciences:

Outcome 1: Awareness of range of careers available that integrate science, such as science education, science writing, science policy. *Assessment*: Student writing in IntSci 301.

Outcome 2: Understanding, through practical experience, with the work of people in one science-based career, such as classroom or informal science education or science policy. *Assessment*: Practicum experience and reflection on it in IntSci 401.

Outcome 3: Familiarity with fundamental ideas in philosophy of science and their applicability to the development of a particular scientific theory. *Assessment*: Oral participation and written work in IntSci 402.

Outcome 4: Familiarity with social and historical context of a particular scientific theory, its development and acceptance. *Assessment*: Oral participation and written work in IntSci 402 and IntSci 403.

Outcome 5: Understanding of ethical issues arising in the scientific process, with study of at least one specific case. *Assessment*: Oral participation and written work in IntSci 403.

Outcome 6: Understanding of reception of scientific theories in the public sphere, political conflicts over the validity or funding of scientific research, conflicts over science education, with study of at least one specific historical or contemporary case. *Assessment*: Oral participation and written work in IntSci 403.

4. Science Research:

Outcome 1: Develop understanding of scientific inquiry. *Assessment*: Oral participation and written work in IntSci 491.

Outcome 2: Understand the research proposal process. *Assessment*: Oral participation and written work in IntSci 491.

Outcome 3: Learn about experimental design. *Assessment*: Work in capstone research project; oral participation and written work in IntSci 492.

Outcome 4: Develop an understanding of the relationship between scientific evidence or data and scientific hypothesis and theory. *Assessment*: Work in capstone research project; oral participation and written work in IntSci 492.

Outcome 5: Learn the challenges of collecting and analyzing data, dealing with ambiguity or complexity in data. *Assessment*: Work in capstone research project; oral participation and written work in IntSci 492.

Outcome 6: Experience in presenting scientific data and discoveries, orally and in writing, to scientific or general audiences. *Assessment*: Oral participation and written work in IntSci 493.

VIII. Program Assessment

An important component of the degree program will be assessment, both internal on an on-going basis and external periodically.

The internal assessment process will be performed in collaboration with the university's Office of Educational Assessment. An initial assessment of the new 400-level courses will be based on student and collegial evaluations, allowing instructors to make revisions and refinements. Once the courses have matured, the Integrated Sciences steering committee and OEA will evaluate how well the courses meet the goals of the program.

The capstone sequence will provide a natural setting for assessment of the effectiveness of the program in preparing students for careers or graduate programs. Direct observation of student performance in class and in research presentations will be supplemented by exit interviews with graduates and follow-up questionnaires two and five years after graduation. The director and steering committee, with the advice of OEA consultants, will review the data and revise the program accordingly.

During the fifth year of the program, the College of Arts and Sciences and the College of the Environment will jointly conduct an external review of the Integrated Sciences degree program, modeled on decadal departmental program reviews. The deans will appoint a review committee and decide on the details of the review process. It would be natural to anticipate that the committee will comprise UW faculty who are not Integrated Sciences participants as well as one or two faculty from other universities who have experience with integrated science programs.

Prior to the review committee's visit, the Integrated Sciences director will prepare a report on the program's accomplishments and challenges, including data on student interest, student performance, and student post-graduate activities. The external review committee will focus on the effectiveness of the degree in meeting student needs. Is the academic program coherent and rigorous? Is it attracting sufficiently many students, and does it provide them with the intellectual content they need? Do they value the program intrinsically for the educational experience it provides, and does it prepare them successfully for graduate program admissions or jobs? Most important, does the program meet a need that existing academic programs do not? For example, does it better prepare students anticipating secondary science teaching careers? The committee will also consider how well the program is administered.

On conclusion of the review, the two deans will decide whether the Integrated Sciences degree program should continue as is, should be revised, or should be terminated. After this initial review, the deans will also decide whether to schedule the next review in five years, ten years, or an alternative interval. It is expected that reviews will occur at least every ten years thereafter.

IX. Diversity Plan

Attracting students from diverse backgrounds to the Integrated Sciences degree program is one of the program's priorities, all the more because of the potential leveraging effect of having program alumni go into careers in formal and informal science education. Diversity issues will be addressed in three domains: student recruitment and retention, program content, and faculty engagement.

1. *Student recruitment and retention.* The Integrated Sciences director will work closely with the leadership of an already successful program on campus, the Pre-Major in Astronomy Program (Pre-MAP). Begun in 2005, Pre-MAP recruits entering freshmen with an interest in mathematics and science who are from traditionally under-represented groups and introduces them right away to research in astronomy, as well as providing one-on-one mentoring and peer support throughout freshman year. Pre-MAP students will be introduced to the Integrated Sciences degree and the careers for which its students are prepared. If they find themselves drawn to continued work in astronomy, they might consider the astronomy disciplinary option and continued research in astronomy within the Integrated Sciences program. Or, if their scientific interests are broader, they can explore those interests within the program.

In addition, the Integrated Sciences staff will work with staff in the university's Office of Minority Affairs and Diversity to identify students from under-represented backgrounds who are doing well in the first-year science and mathematics courses during freshman year. Information about the program will be sent to these students, and they will be invited to a social event at which they can meet some of the program faculty, learn more about it, and ask questions.

2. *Program content.* A standard science course is not the ideal venue for introducing gender or diversity issues. But fortunately, the Integrated Sciences curriculum offers two settings in which these are natural subjects, the IntSci 301 seminar on careers in science and science education and the IntSci 403 course on science in context. IntSci 301 will bring speakers to class to discuss their work in schools, museums, law firms, and so on. Many will be in a position, through their own experiences, to address gender and diversity issues facing people in their professions. The content of IntSci 403 will vary over time, but on some occasions, the challenges of having a more diverse workforce in the sciences will be a central theme. There is also the opportunity, for those students interested in pursuing diversity questions further, to design an IntSci 401 practicum around such an inquiry.

One goal of the integrated sciences program is to better prepare students intending to teach science in secondary schools. Central to this is the preparation of students who will go on to urban high-needs schools such as some here in Seattle. IntSci 301 will allow students to meet with teachers from these schools and to make class visits. In IntSci 401, they can follow up with extended visits to and participation in science classrooms of local high-needs schools. The UW College of Education's Master's in Teaching program has as its goal the preparation of teachers who can ensure "children's success in school, particularly for children in culturally diverse, poverty-impacted communities where academic achievement has historically lagged." The Integrated Sciences program will feed some of its graduates into the

UW MIT program, and can rely on the MIT program for contacts in high-needs schools to assist with practicum placements.

3. *Faculty engagement.* The success of the Integrated Sciences program depends on the recruitment of faculty from across campus to participate as instructors in IntSci 301, 402, and 403 and to serve as supervisors of practica experiences or capstone research projects. The program director will develop a pool of faculty who are women or members of under-represented minorities to take on these roles. There is already a tradition of engagement of women in the leadership of the Integrated Sciences program. Julie Lutz of Astronomy was the initial director of the program and the inaugural IntSci 301 instructor in Spring 2011. Andrea Woody of Philosophy helped develop the concepts for IntSci 402 and 403, serves on the program steering committee, and will be among the first instructors in IntSci 402. Helen Buttemer of Biology and Liz Nesbitt of Earth and Space Sciences are inaugural members of the steering committee, along with Julie Lutz. More recently, Susan Hautala of Oceanography and Kathryn Kelsey of the Seattle Public Schools have played key roles in shaping the vision of the program.

X. Workforce and Community Demand

The 2009 Washington Higher Education Coordinating Board study *The System Design Plan: A Statewide Plan for Moving the Blue Arrow* describes improvements in science and math readiness as "critical to preparing more students to enter the science, technology, engineering, and math (STEM) fields needed in Washington. Today's students are ill-prepared to succeed in college in these fields, however, without considerable remedial work." It further notes that in "some high demand fields, the annual need for workers is twice that of the number of degrees we are conferring in these fields, which include science, technology, ... " and warns that "competition will be especially fierce for talent in research, scientific, medical and computer science fields."

In February 2012, the report *A Skilled and Educated Workforce,* produced jointly by the Higher Education Coordinating Board, the State Board for Community and Technical Colleges, and the Workforce Training and Education Coordinating Board, came to similar conclusions. As noted in the accompanying press release, the report "identifies several employment categories in which demand for workers is expected to outstrip the state's ability to supply those workers through at least 2019. These include computer science, engineering, software engineering and architecture at the bachelor's degree level... . Demand also is projected to be strong in the health professions at all education levels, and in computer science for those with graduate degrees."

To ensure that students are prepared to succeed in undergraduate science and engineering programs, and to encourage more students from diverse backgrounds to consider these fields, secondary schools need a larger corps of outstanding math and science teachers. This is one place where the Integrated Sciences degree can play a role. The National Science Board's 2003 report *The Science and Engineering Workforce: Realizing America's Potential* has as one of its principal recommendations, "In partnership with other stakeholders, the Federal Government should act now to attract and retain an adequate cadre of well-qualified precollege teachers of mathematics, science, and technology." A National Science Board

report from 2010, *Preparing the Next Generation of STEM Innovators: Identifying and Developing our Nation's Human Capital*, recommends "rigorous, research-based STEM preparation for teachers, ... including hands-on and unstructured problem solving and inquiry-based learning." To provide inquiry-based learning, teachers must themselves be steeped in the scientific research process, which the Integrated Sciences degree emphasizes.

A 2012 report from the National Research Council, *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, recommends that "science education in grades K-12 be built around three major dimensions: scientific and engineering practices, crosscutting concepts that unify the study of science and engineering through their common application across fields, [and] core ideas in four disciplinary areas: physical sciences; life sciences; earth and space sciences; and engineering, technology, and applications of science." For this to occur, "prospective science teachers will need science courses and other experiences that provide a thorough grounding in all three of the framework's dimensions. Thus science teacher preparation must develop teachers' focus on, and deepen their understanding of the crosscutting concepts, disciplinary core ideas, and scientific and engineering practices so as to better engage their students in these dimensions."

Again, the Integrated Sciences degree addresses exactly these issues, preparing future secondary science teachers as science professionals through its rigorous course requirements and the capstone research experience. The program is a model for interdisciplinary preparation of science teachers. It is perhaps worth noting one item called for in the *Framework* that the degree does not encompass: engineering and technology. There are not, as yet, engineering courses at a suitable level that can be incorporated in the Basic Science and Mathematics component of the degree. However, the degree structure allows for revision and growth, including the potential to add an engineering component some day.

The lack of a pathway at UW for prospective secondary science teachers is a gap that the program will fill. In addition, students interested in science broadly may be attracted to this degree, and then through it to teaching as a profession. Moreover, the students completing this degree, whatever careers they plan, will be advocates for strong science education programs throughout the state.

The Washington Higher Education Coordinating Board's 2011 *Regional Needs Analysis Report* provides further data on the need to prepare more students for careers in science and engineering and, as well, additional teachers. For example, among what the report identifies as the top 50 growth occupations in King County are middle school teaching (with an anticipated increase of 14% between 2010 and 2020) and secondary school teaching (an increase of 37%). There is large anticipated growth as well in a variety of professions that require a strong science and mathematics base, such as network systems and data communications analysts (an increase of 41%).

The BA degree in Integrated Sciences will be an attractive option not just for future secondary science teachers but also for those students intending to do graduate work in technical fields for which a more interdisciplinary or generalist outlook is valuable. For example, there is need for support staff for companies developing patents within biotechnology, and such staff must have literacy in science. Thus, the degree is likely to contribute to high priority

workforce and community needs in a variety of ways.

XI. Student Demand

The Integrated Sciences degree has been designed to be an attractive option for students with an interest in a range of sciences and the process of science who do not anticipate graduate studies in a particular scientific discipline. Indeed, while our disciplinary major programs provide superb preparation for students intending to go on to graduate school or narrowly-defined careers, a broad-based course of study combined with an intensive research experience and opportunities to reflect on the scientific enterprise are a good alternative for students who eventually pursue careers in patent law, museum technology, management in scientific and technology areas, public policy, and insurance risk estimation. They will form a compatible cohort, receive academic counseling tailored to their needs and interests, and leave with a better understanding of the nature and process of science.

Another set of students for whom the Integrated Sciences degree would be attractive are those planning to enter Master's programs leading to careers in secondary science teaching. According to research by faculty at UW's College of Education, students entering the UW Master's in Teaching program in science have strong content knowledge in their major field, but many have less understanding of science inquiry, that is, how to conduct an investigation or how evidence is used in relationship to hypothesis, theory, and scientific argument. In addition, they have difficulty identifying big ideas and how ideas are integrated with one another. The Integrated Sciences program addresses these gaps through its emphasis on a science research experience, on studying and connecting a range of sciences, and on examining the scientific process itself.

2006 Survey of Teachers. In the initial stages of planning for this degree, a survey was taken of science teachers in the region, with about 65 teachers responding. Additional information was collected through existing contacts some of our faculty have with teachers, and some teachers were invited to a committee meeting. We learned from these outreach efforts that almost all teachers wished they had had more breadth in their undergraduate science training. For many, even though they might have prepared in a particular science discipline, the needs of their school or district have required them to broaden the repertoire of subjects they teach.

We also learned from many of the teachers that their undergraduate education did not provide adequate tools to teach science process to their students. More time for consideration of and reflection on the principles of science would have served them better. Indeed, the need to develop such skills in future teachers is a given, in light of the *Washington State K-12 Science Learning Standards*. Inquiry is one of the three underlying themes of the standards, with students expected to acquire an understanding of what a system is, how to conduct an investigation, and what constitutes valid evidence. The Integrated Sciences degree has been designed to address these issues.

In February 2012, we conducted three new surveys, of teachers, students entering UW's Master's in Teaching program to prepare for careers as science teachers, and undergraduate science majors at UW. Below we discuss what we learned from each survey.

2012 Survey of Teachers. From the teacher survey, we learned that those who had a research experience as students or scientists valued the experience as important preparation for teaching and recognized this as a strong feature of the proposed degree. Many also commented on the benefit of the broad preparation the degree offers. One experienced high school teacher in the region writes, "Requiring future teachers to have instruction in science research and the nature of science (in addition to standard science courses) is paramount. Without understanding how science works, and without having actual experience in a scientific field, too many science teachers end up teaching content without having the context. Students then end up not really understanding how science works ('it's just a theory')." Another says, "I think lab experience is a major advantage I have over other teachers I have worked with. I think many science teachers without much practical science experience shy away from inquiry based labs because they are unsure how to deal with an unexpected outcome. The more experience with the nature of science and inquiry based methods, the more prepared teachers are to help students looking for real science instruction rather than book based instruction. I also believe a strong foundation in ethics and science philosophy will allow teachers to meet more students because it brings the creative human process of science to the forefront."

Let us quote from four more teachers: "I have taught two courses with history teachers at my school: environmental issues and brain and mind. After 40 years of teaching, I realize that it is those courses that ask teachers and students to apply the concepts and processes of our disciplines to core issues is how one really learns. The approach of this new program seems to do exactly that. I waited 30 years before teaching with another teacher in another discipline. These graduates will certainly have a head start on what has turned out to be professional growth for an experienced teacher." And: "I had some 225 undergraduate credits and two bachelor's degrees and was still vastly unprepared to teach science. I learned the content as I went along, but it was more difficult to learn and integrate the two essentials that I see included in your program: what do scientists actually do and what ethical/social/economic impacts does science have on me (the student)? Good luck - it appears to be an excellent step toward better and more broadly trained science teachers." Also: "Where I felt my degree experience was weak, you have put much emphasis. Those 2 areas are the 18 credits of focus and the research experience. I felt my degree was too broad, and not enough in depth, and I feel like a research experience would have helped me immensely in preparing relevant experiences for my students. For those two reasons especially, I really like how you have set up this degree." And finally: "I love the idea of choices and research as key pillars to preparation! I hope that the program will attract some of the great talent of science minded young folks, and then put them in a great place to grow into science educators!"

Of the 107 teachers who completed the survey, 90 considered the Integrated Sciences program to be excellent or good preparation for future secondary teachers and 64 would have considered choosing the major if it were available when they were undergraduates. Several expressed concern that there was a lack of science pedagogy, in many cases due to the misunderstanding that the program is designed to lead to teaching certification as well as a B.S. in science and therefore lacks an essential component. Some believed a disciplinary science degree would be more valuable for high school teachers. For example, one teacher

wrote, "Without knowing what a subject-specific degree requires (such as B.S. in Biology) it is difficult to judge the depth of knowledge that will result from this program. While an integrated approach like this would be great for middle school teachers, the concern is there that teachers will not have the depth of knowledge in a single field that they would need to teach advanced courses such as AP Bio, Anatomy & Physiology, or Biotechnology." Students who anticipate careers devoted to teaching in a specific discipline – biology, for example, or physics – will surely benefit from a degree in that discipline. Some may be better advised to select that course of study. However, as many respondents testified, the Integrated Sciences degree will provide a valuable option, one not currently available.

Survey of Future Teachers. The incoming Master's in Teaching students form a small group. As a result, we received only four responses. Three considered the program good or excellent preparation or future science teachers. The three who had research experiences considered them to be a valuable part of teacher preparation. One wrote, regarding the new integrated science courses, that "ALL of them would have been extremely beneficial and applicable as I pursued my career path – some of these subjects are touched upon in passing during the subject courses, but it is left to the student to pursue more in-depth information on their own. … Even if a future teacher plans to specialize in one discipline of science, I feel strongly they can't do it without a strong, broad foundation based on all of them. This course path sounds like it ties it all together nicely."

Survey of Science Majors. Science majors across the university were given a short description of the Integrated Sciences program, then asked what they thought about it, whether they would have considered it when they selected their majors, and whether it would be good preparation for their career plans. We received 191 replies. From the data we obtained, we can tentatively conclude that the degree would indeed be attractive. Almost three-fourths (73%) of the respondents said they considered the major excellent or good, with almost all the others judging it okay. When asked if they would have considered the major had it been available, 57% agreed. And when asked if the major would provide good preparation for a career they are considering, 46% agreed. Three students, on receiving the survey, took the initiative to write to faculty members developing the program to ask if they could begin the major now.

One student wrote in the comment section of the survey, "I would have loved this degree! It seriously would have been perfect for me." Others echoed this thought: "This program sounds amazing! I wish I had access to a major that allowed me to be prepared for teaching in secondary education sciences. I would gladly join this major if I had access to it." Also: "I really wish I could be a part of this major. It is appealing, well put together, and amazingly helpful for someone like me who is thinking of pursuing teaching." And: "I truly believe this program has promise. If it had been available to me as a freshman I would have very likely pursued it. … This program seems very focused and in depth and I believe students who are attracted into this program as freshman will undoubtedly serve as excellent teachers and experts in their fields of choice. Very interested to see how this program turns out!" The most common reservation expressed by students was that the program did not provide sufficient depth in a given discipline, especially if they were planning to attend graduate school or do research in that discipline.

Our surveys confirm that the Integrated Sciences program will serve future science teachers well, and may even serve to increase the interest in teaching careers from among UW undergraduates. Efforts will be made to publicize this option and provide high-quality advising for students thinking about teaching careers, in collaboration with faculty and staff in the College of Education. The student survey suggests that the program will also serve the needs of students anticipating the various careers that have been discussed throughout this proposal.

XII. Articulation

Articulation with two-year colleges: The requirements for admission to the Integrated Sciences program were described in Section II of this document. Recall that a student "must present a minimum of 45 academic credits at the time of application from the Basic Science and Mathematics courses listed [earlier], with a minimum of 15 credits in each of two fields and a minimum of 15 credits combined from the remaining three fields." In addition, the applicant must have a minimum cumulative 2.50 GPA for all college coursework, a minimum cumulative 2.50 GPA for all required Basic Science and Mathematics courses, and a minimum grade of 2.0 in each Basic Science and Mathematics course.

A student transferring to UW from a two-year college who meets these requirements, whether through coursework at the two-year college for which transfer credit was received or through coursework at UW, would be eligible to apply on equal terms with other UW students. The basic courses in mathematics, biology, chemistry, and physics are typically available at a two-year college, as would be some version of a geology course, though perhaps not the equivalent of ESS 211-213. Nonetheless, transfer students will be able to take sufficiently many courses at a two-year college to meet the 45-credit Basic Science and Mathematics admissions requirement upon arriving at UW.

Articulation with Master's-level education programs: A student completing the B.S in Integrated Sciences will have fulfilled all the prerequisites for the UW College of Education's Master's in Teaching endorsement in science, regardless of the disciplinary track chosen. Applicants to the M.I.T. program are required to complete a course on education of an ethnic group in the United States, which they could fit into their programs of study as an elective, and devote a minimum of 40 hours to classroom observation and participation in a high-needs school. A student may wish to meet this second requirement independently of the Integrated Sciences requirements, but the student would also have the option of building his or her IntSci 401 practicum work around the necessary classroom experience. Thus, with suitable planning, Integrated Sciences majors will meet all the admissions and science endorsement requirements of the UW M.I.T. program.

Many UW graduates prepare for teaching careers by attending Seattle University's Master in Teaching program. Applicants to that program must submit forms to demonstrate that they meet the requirements for endorsement to teach in various fields, such as biology, chemistry, earth and space sciences, physics, or science. For each of the disciplines, an applicant must have taken a minimum of 30 quarter credits in the field, including a lab course. For the

science endorsement, a student must again have taken 30 credits, including a lab course in one of the four disciplines and at least one course in each of the other three. With appropriate choice of disciplinary track, an Integrated Sciences student will have fulfilled these requirements and more.

Another program that UW graduates may wish to attend is the Master in Teaching program at Evergreen State College. Evergreen's science requirements for endorsement in Biology, Chemistry, Earth and Space Science, Physics, and Science are substantial. In some cases, they go beyond the minimum an Integrated Science graduate would do in the basic and disciplinary track course work. But in all cases, the Integrated Sciences requirements form a significant portion of the endorsement requirements, and with the research experience taken into account, a student could meet Evergreen's expectations. The Science endorsement requirements, to take one example, would rarely be satisfied by a student in a traditional science major. In contrast, the Integrated Sciences graduate would satisfy all the breadth expectations and would merely have to do a little more course work in the chosen disciplinary track. The capstone research experience may well be sufficient to satisfy this.

In all three cases – the Master's-level education programs of UW, Seattle University, and Evergreen -- program alumni will be prepared for admission with science endorsements.

XIII. Preparation for a Variety of Occupations

The Integrated Sciences program provides an education in science that would be appropriate for students interested in a range of careers, as has already been noted. In this section, some of these careers are examined more closely, with a description of what a student would need to do upon graduating in order to be prepared for each career.

1. *Secondary science teaching.* This has just been discussed in Section X, in the subsection on articulation with Master's-level education programs. As described there, graduates of the Integrated Sciences program will have completed all the science coursework needed for a teaching endorsement in science. Through a suitable choice of activity in the IntSci 401 practicum course, a student can also acquire the classroom observation experience required, for example, by UW's College of Education for its Master's in Teaching program. Upon completing that program, or its equivalent, a student would be prepared for secondary science teaching positions in Washington State.

2. *Informal science education in a museum setting.* A student wishing to embark on a career in a science or natural history museum would need a strong background in science, which the Integrated Science degree provides. In addition, the student would be advised to obtain a professional degree in museum studies such as the Master of Arts in Museology offered here at UW. A review of the admissions requirements for the Museology program shows that the student would be qualified to apply after completing the Integrated Sciences degree. The Museology website notes that the ideal applicant would have an academic background that "might include the hard sciences, social sciences, humanities or research, education and design." Also desired

would be "experience working in museums or informal learning environments," which an Integrated Sciences student could acquire as part of the IntSci 401 practicum experience.

3. *Science writing.* The Council for the Advancement of Science Writing has *A Guide to Careers in Science Writing* at its website (see http://casw.org/casw/guide-careers-science-writing) with valuable advice. It recommends that students major in science or journalism as undergraduates, taking courses in the other area as well and, if possible, writing stories for school newspapers and magazines. Thanks to UW's highly ranked Department of Communication, an integrated sciences major would have ample opportunity to take communication courses, such as courses on interviewing principles and practices, writing for mass media, and multimedia journalism. The IntSci 401 practicum would provide an opportunity to work with a local media outlet on journalism.

   The Council also recommends attending a graduate program in science writing to acquire specialized training. One example is M.I.T.'s one-year program leading to a Master of Science in science writing (http://sciwrite.mit.edu/). No single course of study is required for applicants. The website observes that "science writers respect scientists and engineers, but don't treat their work as privileged, or as immune from informed criticism. Science writers never forget that the work of science takes place within a human and historical frame—and supply their readers with that context as needed." The Integrated Sciences curriculum strives to develop this very understanding of science.

   Another notable example is UC Santa Cruz's one-year Science Communication graduate certificate program (http://scicom.ucsc.edu/about/index.html), which requires of its applicants a Bachelor's degree in science or engineering and six months minimum of academic research or professional experience. As a last example, Johns Hopkins has a one-year Master of Arts in Science Writing (http://writingseminars.jhu.edu/graduate/ma-science-writing.html), for which the only specific prerequisite is a Bachelor's degree, although applicants must also submit sample stories on science intended for general readers.

4. *Science policy.* The Integrated Sciences program is not a policy program, but it will give students the science base they need before applying to graduate policy programs. As an example of the path a student could take after completing the BA in Integrated Sciences, The Gerald R. Ford School of Public Policy at the University of Michigan has a Science, Technology, and Public Policy graduate certificate program that one can take in combination with their Master of Public Policy (or, for that matter, in combination with graduate study in a scientific field). The principal requirement for admission, other than a strong academic record, is demonstrated understanding of how the program's coursework might be integrated into one's professional pursuits. One can similarly combine a Master's program in policy at Princeton's Woodrow Wilson School of Public and International Affairs with their certificate Program in Science, Technology and Environmental Policy.

5. *Professional School.* A student intending to apply to medical school, veterinary school, or dental school will typically have met all the science requirements for admission through the course work required by the Integrated Sciences degree. In some cases, it may be desirable to include additional biology courses either as electives or through the choice of biology as the disciplinary track. The required courses on nature of science and science in context, the capstone research experience, and the practicum allow the integrated sciences major to acquire additional background that will be useful for admission to professional schools in these fields.

   Students completing the integrated sciences program will also be well prepared for law school admission and law school itself. A student anticipating a law career related to science, such as patent law or environmental law, would find the integrated sciences program especially valuable preparation, and can tailor the choice of disciplinary track, practicum, and research with such a career in mind.

XIV. Other Integrated Science Degree Programs

At the University of Washington: There is no integrated sciences degree already in place at UW. One program that might be regarded as an analogue, and a very successful one at that, is the Program on the Environment (PoE), housed in the College of the Environment. Like the integrated sciences degree proposed here, it has foundational courses from several sciences (and social science), plus a set of environmental studies courses that are the counterpart to our integrated sciences courses. In place of our disciplinary tracks, PoE requires a set of courses on environmental perspectives and experiences. Finally, PoE has a rigorous capstone experience that allows students to learn outside the classroom and supplement that outside learning with seminars.

Elsewhere in Washington State: Central Washington University offers teaching major options within specific science departments leading to endorsements for secondary teaching, but no major comparable to the one proposed here. Eastern Washington University offers a BA in Education with a secondary option in a science field, but again, no comprehensive integrated science degree program. Likewise, Washington State University has undergraduate education degrees coordinated with studies in a particular field of science, plus a general science endorsement, but again, no comprehensive program.

The one program in Washington State that can be compared to the degree program proposed here is Western Washington University's Education BA in general science. It's an excellent program, geared specifically to future secondary teachers. However, like the others, it differs from ours in its more limited offerings on the nature of science and the absence of a research component.

Beyond Washington State: Several universities in the United States have degree programs with "Integrated Science" in their titles. Perhaps the one that merits a close look is the Integrated Science Program (ISP) at the University of Arizona. Before taking that look, let us mention three other programs:

(i) The Integrated Science Program at Northwestern University (http://www.isp.northwestern.edu/about/index.html). This appears to be a fabulous program, but one very different in conception. It is an intensive, accelerated, honors-style degree with is own faculty and a house that serves as the administrative home as well as containing a classroom, computing facilities, and a lounge available to majors 24 hours a day.

(ii) The Integrated Science and Technology degree at James Madison University (http://bsisat.jmu.edu/index.html). This is a degree offered by an entirely separate department at the university, the Department of Integrated Science and Technology, with its own faculty. Students have the opportunity to design their own course of study.

(iii) The Integrated Science and Technology degree at Marshall University (http://www.marshall.edu/ISAT/). This is another example of a degree program that is offered by a department of integrated science and technology.

The Integrated Science Program at Arizona (http://is.arizona.edu/index.html) describes its primary goal as providing "talented undergraduates with an opportunity to pursue studies that go beyond the traditional major in a single field of science. Through coursework, research projects, and internships, ISP students explore the interrelationships among the sciences, the boundaries along which new fields are born, the discoveries made possible by cross-disciplinary research, ... The ISP is designed to provide training in critical thinking, analytical and quantitative problem solving, teamwork, and scientific writing/presentation that cross the boundaries of scientific disciplines, while at the same time ensuring that students have a depth of understanding in a traditional field."

The ISP degree has four components:

(i) Science Foundation Courses. These are required courses in mathematics and statistics, computer science, physics, chemistry, and biochemistry.

(ii) ISP Courses. Two 4-unit courses have been designed at the 300 level, Explorations in Integrated Science and Key Concepts in Biology. The first has four modules on topics such as protein synthesis and folding, multiscale modeling, and entropy. The second addresses contemporary issues in biology, such as evolution of bacteria in human disease and natural selection in relationship to global climate change. In addition, students take a 1-credit introductory seminar at the 100 level, another 1-credit seminar at the 300 level, do 6 credits of research, write a thesis, and take a 2-credit senior seminar on scientific writing and presentations.

(iii) ISP electives. Students take a physical science or mathematics elective from a designated list, a biological science elective from another list, and an integrated science elective from a list of courses such as neurobiology, global change, theoretical astrophysics, and philosophy of science.

(iv) Minor. Students complete a minor in a field of science chosen from the College of Science, the College of Engineering, the College of Agriculture and Life Sciences, or the College of Medicine.

A comparison of Arizona's ISP degree to the one proposed here suggests that at Arizona more science courses are required, whereas here there is greater emphasis on the science research experience, placing science in context, and reflecting on the nature of the scientific process. Arizona's College of Science, which offers the ISP degree, offers as well a BS degree in Science Education (http://tpp.arizona.edu/stpp/index.html) with concentration in biology, chemistry, earth science or physics, the outcome of which is teacher certification. Thus, the ISP degree is not designed with the needs of future educators in mind. Arizona's ISP is a strong program, but one with goals different from ours.

XV. Conclusion

The degree program in Integrated Sciences proposed here will provide many benefits to the university community and the state. A new science program will better serve the needs of some of our students now selecting other science majors. Among these, certainly, are students preparing to be science teachers. But equally well, the degree will better meet the needs of any student whose ultimate career will require a broad scientific base and an in-depth understanding of scientific process, such as the aforementioned museum professionals, science writers, patent lawyers, policy analysts, and for that matter those students who simply want an education in the basics of science. By bringing together students with a range of perspectives on science, the program will create valuable opportunities, through the seminars and courses the students take together, for them to learn from each other.

In meeting the needs of such a range of students, the degree will also contribute to some urgent state workforce needs. Most notably, improved K-12 science education is a prerequisite for preparing the state's students in their post-secondary studies and careers in science, engineering, and technology fields. The graduates of this program will be well prepared to educate the coming generations of students, and to keep up with changes in scientific knowledge in the years to come.

As a side benefit, the program will encourage conversations among faculty members across the university on science education issues. Indeed, this has already begun as part of the planning process for the degree, with science and science education faculty from the College of Arts and Sciences, the College of the Environment, and the College of Education meeting regularly for lively and stimulating discussions about how best to offer this new degree. The faculty's collective interest in improving science education on this campus is immensely encouraging, and a sign of the benefits to come.

Jennifer A. Payne

From: Ron Irving <rsi@uw.edu>
Sent: Thursday, November 08, 2012 2:28 PM
To: Bradley Holt
Cc: Jennifer A. Payne
Subject: Integrated Sciences BA-BS

Dear Brad (and SCAP),

The Integrated Sciences steering committee met yesterday afternoon to discuss changing our proposed degree from a BS to a BA. We had some difficulty in grappling with this issue, due to a lack of clarity regarding the underlying principles we should use to judge whether a degree program is a BA or a BS. If there were some well-defined list of criteria on which we could rely, this would be a simple matter, for us and perhaps for SCAP and FCAS as well. In the absence of such criteria, it appears that we -- and you -- are left to rely on existing precedent. We found that this made it difficult to make a coherent argument one way or the other. Of course, ultimately a decision must be made, and as the governing body on such matters, FCAS will make that decision. However, in the absence of any college or university guidelines, we believe we are all operating under a handicap.

We examined the issue from several angles:

1. Is there an intrinsic set of properties that distinguishes a BA from a BS, and which of these properties does our proposed degree have?
2. If not, do we define BA and BS degrees by reference to existing precedent? In that case, how do we understand that precedent and what does it say about our degree proposal? Moreover, the label attached to our degree itself becomes part of existing precedent. Will this be a good precedent for other programs? That last question isn't in our bailiwick, but we did give it some attention.
3. What impact will BA versus BS have on our majors when they apply for jobs, graduate schools, or professional schools?
4. What impact will BA versus BS have on our ability to attract students to the degree program?

We had difficulty reaching a consensus on the answers to these questions. The initial problem is the absence of an answer to #1. If #1 had an answer, then the other questions would be moot. If our program is intrinsically a BA, or intrinsically a BS, then that's what it is, regardless of impact on students, and so on. Once we recognized that #1 has no answer, we had no firm ground on which to anchor our decision. Nor, for that matter, does FCAS, as far as we can tell, and this is an unsatisfactory situation.

Moving on to #2, we read the comments you sent me in your email closely. You mention that BA degrees are broader, BS degrees have more depth. We looked at the examples in Biology, Chemistry, and Biochemistry. It wasn't clear to us in what sense the BA degrees are broader. Less demanding, yes. Broader? We didn't see that. One committee member pointed out that outside the sciences -- in history, say -- one could can get a BA that is not broad at all, but would be extremely narrow. And deep. The breadth versus depth distinction would appear to be reserved for science degrees, which makes sense, since students don't get BS degrees outside the sciences. And to confuse matters further, we all recognize that at many liberal arts colleges and other universities, students get BA degrees regardless of field. Thus, what's at stake here is purely a local matter, within UW, and to the extent that we could conclude anything from the existing examples, BA degrees tend to be not broader but weaker.

It is on this point that the committee was not convinced that our degree should be a BA. Is it broad? Yes, for sure. But we are also convinced that in its own way it is deep. Not deep in the sense that it prepares one for a PhD program within a particular scientific discipline. But deep in its emphasis on science itself as an object of study, with students learning a variety of disciplines, studying one in more detail, examining the nature and social context of science, and participating in research with a parallel opportunity to reflect on that experience. This is not a weak degree. It is a demanding degree. If one defines demanding by examining the first digits of the course numbers we require in our disciplinary tracks, one may

reach a different conclusion. But the committee felt strongly that this is a misreading of our proposal and wished for me to make the point one more time that we see our degree as one that is, yes, broad, but also at the same time deep.

Regarding the impact issue I raised in #3 above, our sense is that schools and employers are not likely to be interested in the BA-BS distinction, in part because of the many schools that offer BAs only. It really is an internal issue. For this reason, committee members were concerned about #4, what impact the BA-BS distinction may have on attracting students. Given that we believe this is a strong program, both broad and deep, we would not want a student under the impression that BA has the connotation "weak" to give our program less attention than it merits. In particular, we don't want students contemplating secondary teaching careers to fear being relegated to second-class status (to quote one of our committee members). Our degree offers what we believe future teachers need, from education in a multiplicity of sciences to laboratory training, integration of sciences, participation in a research experience, and exploration of the broader context of science. If student perception is that within science disciplines, BA degrees are light degrees, then we are doing a disservice to potential teachers, and may fail to attract to the field some of the students we need.

Late in our discussion, one of our members came upon the description of the BA and BS degrees in public health. FCAS must have approved these degrees fairly recently. An examination of them left us even more confused. The difference between them appears to be the number of science credits, the BS requiring a good deal more. Yet, our science requirements are more demanding still. Like ours, both public health degrees can be viewed as broad, given the many fields from which courses must be taken. Unlike ours, they ask their majors to do less science.

In the end, we were puzzled. Any approach we took to coming up with a definition of BA versus BS against which to weigh our proposal led us to the conclusion that what we are proposing is a BS. On this basis, we would like you to reconsider your suggestion that we revise our proposal to call our degree a BA.

Notwithstanding our strong belief on this matter, and our concomitant desire that you reconsider our proposal as is, we do not wish for this process to continue without conclusion. If after reconsideration you conclude that our degree meets the criteria for a BS and are prepared to forward it to FCAS on that basis, we will be delighted. If, however, you conclude instead that we have fallen short, then even though we will disagree with you, we are prepared to accede to your suggestion that we change the degree to a BA and would welcome a review by FCAS on that basis.

Thank you for your time on this.

Sincerely,

Ron

Tri-Campus Review of Integrated Sciences Degree
Steering Committee Response
January 17, 2013

The Integrated Sciences steering committee met yesterday and discussed the nine Tri-Campus review comments on the degree. We found three issues to address: whether the degree should be a BS or a BA, why psychology is not one of the degree's disciplinary tracks, and whether integrated science majors would be able to fulfill the program's research requirement. I will discuss our views on these issues by reviewing the comments one by one.

1. Sian Davies-Vollum focused on the question of whether the degree should be a BA or BS. Drawing on the contrast at UWT between the BA in Environmental Studies and the BS in Environmental Science, she concluded that the proposed degree has too much science to be a BA (or so it appears, but there's a confusing typo). We have already made this argument. We have nothing to add.

2. Bruce Balick argued that the points I made about BA versus BS should be addressed, presumably by SCAP and FCAS. We have nothing to add.

3. Jody Bourgeois agreed with what I wrote and with Sian Davies-Vollum, asking for the counter-argument that the degree should be a BA. Again, we have nothing to add.

4. Erica Cline found it "quite obvious" that the degree "is designed as a rigorous BS degree rather than a BA." She suggested, like Sian, that we look to the UWT environmental degrees to make a stronger case for this. We come again to the question of whether a case is to be made on abstract principles or by comparison to existing models. The UWT Environmental Science degree is of no use as a guide if one distinguishes BA degrees from BS degrees by appeal to principle. However, if we take the empirical approach, then a review of its requirements suggests that our degree merits the BS designation as much as theirs. In particular, comparing the Environmental Science Biology Track to our program led us to the conclusion that our program is as demanding in its science requirements.

5. Laura Little agreed that the proposal is "more in line with a BS degree than a BA." Once again, we have nothing to add. She also wondered why psychology isn't one of the disciplinary tracks. We can certainly imagine adding a psychology track in the future, and other tracks as well. Initially, however, our goal has been to include tracks corresponding to the departments that offer courses a student might take in preparation for a career in secondary science teaching. This led to the nine current participating departments.

6. Don Janssen found the degree to have insufficiently many credits above the sophomore level and said it "hardly seems like a candidate for BS consideration." Moreover, he found it problematic even as a BA. A student can indeed complete the degree with less than 45 credits at the 300 level and above if the student chooses certain disciplinary tracks. This is a point we discussed with SCAP at some length two springs ago. We require every integrated sciences major to take 18 credits of rigorous science courses in a track, as well as the required 27 credits at the 400 level in integrated sciences and research courses (and 1 credit at the 300 level). How those courses are numbered is of less concern to us than

how demanding they are. To take one example—chemistry—we have discussed the track requirement with Chemistry faculty in detail and they have assured us that this is rigorous. Organic chemistry is the heart of the requirement. Although it is numbered at the 200 level, we do not believe this is a problem because what counts is substance, not numbers.

7. David Pengra reviewed the arguments for BA and BS, concluding that the degree looks like a BS from a university perspective, yet looks like a BA from the perspective of participating science departments. He then took up a separate issue, whether integrated science students will have sufficient disciplinary background to do research in one of the track disciplines. He raised the important point that supervisors will need to be in a position to "take advantage of the cross-disciplinary backgrounds of these students. How many faculty across the disciplines" can do so?

   On the first issue, yes, in some science disciplines there are both BA and BS degrees, the BS degree requiring more courses. That still doesn't address, to our minds, the meaning of BA versus BS and how this meaning is defined. Is it merely counting credits? As we have argued already, we believe that the degree is a BS and that credit counting is not a reliable guide (unless one defines it so).

   The second issue is important. We have chosen to start small, with a limited number of majors, so that we will not make too large a demand on potential advisors and will be able to develop expertise at finding suitable advisors. Moreover, our program is spread across nine disciplinary units, with our students free to seek research advisors not just within but beyond the nine departments—in the health sciences, engineering, or off campus. We anticipate lots of opportunities, especially cross-disciplinary ones for which our students may be especially well equipped. Nonetheless, we take Pengra's warning seriously and will make every effort to ensure that our students find suitable advisors.

8. Oliver Fraser agreed with David Pengra that integrated sciences students (and current teachers) may need a different approach from those who can jump right into a lab, but argued that this can be done, and has been in Astronomy. "We don't have any trouble finding projects for students who are enthusiastic, but not technically skilled. ... we've found that post-docs and grad students often make great mentors." We share Oliver's belief that we will be able to find suitable advisors for our students and are heartened by his experience.

9. Doug Sprugel argued that the BA versus BS distinction shouldn't come down to broad and shallow versus narrow and focused. It's common sense, he suggested, that this degree is a BS. We neither agree nor disagree. We think, rather, that his argument highlights once again the unfortunate lack of governing criteria on which to rely.

In conclusion, we continue to believe that a BS designation for our degree is appropriate, and find that the tri-campus review comments lend credence to this view. However, we have no desire to beat a dead horse. If this is no longer an option, let's move on. We benefited from David Pengra's perspective on the challenges we may face in having students fulfill the research requirement. We anticipate being able to meet this challenge and look forward to doing so. We are eager to get started on the Integrated Sciences degree and hope to soon. Thank you for your consideration.

Seattle: Bachelor of Arts degree in Integrated Sciences (INTSCI-20110401R)

uwcr
uwcr
Board owner

Posted Dec 7, 2012 4:01 PM
Edited Dec 7, 2012 4:02 PM by uwcr (Board owner)

Please review the attached 1503 pdf requesting to establish a Bachelor of Arts degree in Integrated Sciences at the Seattle campus and post comments by 5:00 pm on Friday, January 11th.

If you have any problems viewing the attachment or need disability accommodations, please contact the University Curriculum Office at uwcr@uw.edu.

Attachments:

- INTSCI-20110401R.pdf94.5MDownloadView

ksdavies
SIAN DAVIES-VOLLUM

Posted Dec 10, 2012 11:44 AM

Having read the argument for whether this degree should be a BS or a BA I really think it shoudl be a BS. At UWT we have a BS in Environmental Science and a BA in Environmental Studies - the BA has lots of non-science course requirements (e.g. communications, social science courses). The proposed degree seems to have way to much science to be considered a BS. Sian Davies-Vollum (Coordinator of Environmental Program at UWT)

balick
BRUCE BALICK

Posted Dec 10, 2012 12:07 PM

The points made by Ron Irving and his group are poignant and relevant. They should be addressed.

jbourgeo
JOANNE BOURGEOIS

Posted Dec 10, 2012 1:25 PM

I tend to agree with Ron Irving's post and also Sian Davies-Vollum that this is a BS degree. Where is the counter-argument (that is, why was it changed to a BA?)? May we see that?

ecline
ERICA T CLINE

Posted Dec 10, 2012 1:42 PM

Reading the final letter in the pdf of the proposal helped me to understand

the confusion a bit. It seems quite obvious from the course requirements that this is designed as a rigorous BS degree rather than a BA. In my opinion, what separates this degree from a BA is that there are only 13 credits required that are not traditional core science courses or disciplinary research and writing capstone experiences. If this were intended to be a BA degree, it would be helpful to strengthen the core (currently 13 credits) to include non-disciplinary communication skills (i.e., communication to non-scientists rather than writing a traditional lab report/journal article--very different genre and style of writing). Also require more electives that would allow students to reflect on the context of science, rather than electives drawn from the disciplines themselves. Of course, that would come at the cost of being able to require quite as much breadth and depth in science foundational courses. It might be helpful to look at the UW Tacoma Environmental Sciences BS curriculum (in contrast to the Environmental Studies BA curriculum), as this may be one of the closest degree programs to the Integrated Sciences curriculum, as proposed. Perhaps by comparing our current BS degree to this proposed degree, they might be able to make a stronger case for making this a BS not a BA?

llittle
LAURA M. LITTLE

Posted Dec 11, 2012 7:29 AM

I agree that this seems to be more in line with a BS degree than a BA. I wonder, additionally, why psychology is not one of the natural sciences disciplinary tracks.

d6423
DONALD J. JANSSEN

Posted Dec 11, 2012 7:41 AM

This degree can be completed with fewer than one year's worth of credits (45) above the sophomore level.
This hardly seems like a candidate for BS consideration.

Actually, I even find it problematic that a BA could be completed with over three years being at the freshman or sophomore level. Shouldn't there be a requirement that at least 45 credits be at the 300-level or above?

Don Janssen

dbpengra
DAVID B. PENGRA

Posted Dec 12, 2012 10:43 AM

Arguments for making the degree a BS:

- Mostly science courses are required.
- Better branding: BS "looks better" to potential employers, post-grad programs and students interested in the program.

Arguments for making the degree a BA:

- Few advanced (4xx) disciplinary courses required, much fewer than BS degrees in the related disciplinary tracks.
- Emphasis on process of science and social/philosophical aspects plus broad range of science courses required.

I agree with many of the points raised by Ron Irving, and echoed above in some posts, namely, (1) there is no University-wide criteria for distinguishing a BA from a BS, nor is there a consistent precedent, (2) "breadth" vs "depth" does not mean very much, (3) rather few people outside of UW would pay much attention to a BS vs BA, and indeed many institutions (including my alma mater) only grant one degree, BA, regardless of discipline.

A BA in science would naturally have more science courses than a BS in a non-science (e.g., economics). The different degrees mainly distinguish the requirements within a discipline. If a BA in science looks like anything, it looks more like this degree than the BS does. The branding issue is not worth worrying about; see (3) above.

In the science disciplines that offer both degrees, such as chemistry or biology, the BS is more quantitative - has more math, relative to the BA. In fact, comparing the BA degrees within science disciplines to the proposed INTSCI degree, one sees that the math requirements are generally higher, and there are more advanced theory courses. So, while across the University, the proposed degree looks like a BS, it is much closer to a BA degree when viewed from the perspective of the participating science departments.

Indeed, the degree is more one ABOUT science than one IN science. The advanced courses as described are quite "meta", e.g., "Nature of Science" and "Science in Context", and courses on how to do research in a general sense. If we take the example of physics (my department), the course requirements of the degree are so light on significant theory courses that a student in this program would be very unlikely competent to conduct research in *physics*; at best, he or she could research problems in physics education, explore philosophical questions, or perhaps physics related social issues.

Overall, I am most bothered by the heavy emphasis on "research" when it appears that the requirements leading up to the capstone year may be insufficient to prepare the student for research within one of the disciplinary tracks. To make this successful will require faculty supervisors who can take on students who may have shallow disciplinary preparation. What I fear is that such projects will often be spent by students simply learning the basics of their field that they could have gotten more efficiently and thoroughly by taking the department's advanced courses. Honest research (not just studying) will require supervisors who can take advantage of the cross-disciplinary backgrounds of these students. How many faculty across the disciplines could supervise these students?

David Pengra (Physics)

ojf
OLIVER J. FRASER

Posted Dec 20, 2012 12:08 PM

The multi-disciplinary nature of this degree seems like a real help to people who plan to go into secondary teaching. The high school teachers I work with often teach a pretty wide variety of courses as one of a relatively small group of "science teachers" at their schools, and they'd be well served by taking this variety of courses.

Regarding David Pengra's point regarding the student's preparation for research: He's certainly right that these students will require a different kind

treatment then those who can jump right into the lab. However, we've had a lot of success with this sort of student in the Astronomy department. In particular, several years ago we hosted two high school teachers* who finished a research project on our 30" telescope. While they probably do not have the theoretical understanding of our best majors, their research experience is likely more transferrable to their classes and has a bigger impact on their teaching. We also run research projects with a group of freshman every Autumn as part of our Pre-MAP program. We don't have any trouble finding projects for students who are enthusiastic, but not technically skilled. It certainly can be a challenge to initially envision projects that are a good fit to these students, but we've found that post-docs and grad students often make great mentors. Ideally people would have a lot of both "breadth" and "depth", but then an undergrad degree would take 7 years, and people who intend to teach or go into informal education settings wouldn't be as well served.

* One of whom just won his district's teacher of the year! (I'm taking some credit for his success--just like a true teacher! =)
http://www.shorelineareanews.com/2012/04/vince-santo-pietro-2012-shoreline.html

sprugel
DOUGLAS GEORGE SPRUGEL

Posted Jan 8, 2013 6:11 PM

When in doubt about how to describe something one should always fall back on common sense and plain English. So if "Arts" and "Science" in UW Bachelor's degrees have anything like their usual English language meanings, the extensive science course requirements clearly mark this as a Science degree, even though it has more than the usual component of humanities. If "Art" is code for "broad and shallow" and "Science" is code for "narrow and focused", maybe it is a BA, but in that case we should probably award BS degrees to every humanities major who concentrates on one area enough to take advanced courses in the field. (BS in Italian Literature?) The great majority of potential employers will not look at the name of this degree in the context of other STEM degrees at UW; they will rely on common sense and assume the title means what it says. So unless we want to send out code manuals with our diplomas, it would still make more sense to give words their usual meaning and call this a Bachelor of Science.

UNIVERSITY CAMPUSES UNDERGRADUATE PROGRAM REVIEW PROCEDURES**

CHECKLIST

Title of Proposal: Bachelor of Arts degree in Integrated Sciences (INTSCI-20110401R)

Proposed by (unit name): College of Arts and Sciences

Originating Campus:

_X_UW, Seattle

___UW, Bothell

___UW, Tacoma

I. **Phase I. Developed Proposal Review** (to be completed by Originating Campus' Academic Program Review body)

A. Review Completed by: (list name of program review body)

Chaired by:

11/30/12 Date proposal received by originating campus's review body

12/04/12 Date proposal sent to University Registrar

12/07/12 Date proposal posted & email sent to standard notification list

01/25/13 Date of originating campus's curriculum body approval
(Note: this date must be 15 business days or more following date of posting)

B. ____8__ Number of comments received. Attach the comments and a summary of the consideration and responses thereof : (1-2 paragraphs)

II. **Phase II. Final Proposal Review** (to be completed by FCTCP)

A. Review Completed by:
___ FCTCP subcommittee
_X_ FCTCP full council
Chaired by: William Erdly

2/6/13 Date request for review received from University Registrar
2/17/13 Date of FCTCP report

B. Review (attached)

YES NO
_X_ ___ Was notice of proposal posted on UW Website for 15 business days?
_X_ ___ Was notice of proposal sent to standard mailing list 15 business days in advance of academic program review?
_X_ ___ Were comments received by academic program review body?
_X_ ___ Was response to comments appropriate? (explain, if necessary)
_X_ ___ Was final proposal reviewed by FCTCP within 14 days of receipt?
_X_ ___ Was there adherence to the University Campuses Undergraduate Program Review Process? (explain, if necessary)

C. Recommendation

_X_ Forward for final approval
___ Forward to Provost because of University issues (Explain)
___ Return to campus council because of insufficient review (Explain).

**Endorsed by Faculty Senate Executive Committee, 1/10/05, modified 1/31/06; These procedures apply to new undergraduate degrees, majors, minors (and certificates) and substantive changes to same