UNIVERSITY OF WASHINGTON

CREATING AND CHANGING UNDERGRADUATE ACADEMIC PROGRAMS

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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 Science 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**

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: 3/31/11
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:

POST TRI-CAMPUS APPROVAL (when needed)

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

Admissions Requirements:

The Integrated Sciences program offers admission to upper division applicants for autumn and spring quarters.

1. A minimum cumulative 2.50 GPA for all required basic math and science courses.
2. A minimum grade of 2.0 in all basic math and science coursework.
3. Since eligible applicants exceed the space available, acceptance is competitive. 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
    d. Evidence of research interest or skills, and the promise of achievement in a science or science education career.

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, regardless of admission group.

Basic Mathematics and Science (45 credits): minimum of 15 credits in two of the below fields and an additional 15 credits chosen from the remaining three fields.

- a. Biology:
    - i. BIOL 180; BIOL 200 (required)
    - ii. BIOL 220 (optional)
- b. Chemistry:
    - i. CHEM 142/CHEM 144/CHEM 145; CHEM 152/CHEM 154/CHEM 155 (required)
    - ii. CHEM 162/CHEM 164 (optional)
- c. Earth and Space Science:
    - i. ESS 211; ESS 213 (required)
    - ii. ESS 205 or ESS 212 (optional)
- d. Mathematics:
    - i. MATH 124 or MATH 134; MATH 125 or MATH 135 (required)
        Note: Q SCI 291; Q SCI 292 (Pending).
    - ii. MATH 126, MATH 136, Q SCI 381, or STAT 311 (optional)
- e. Physics:
    - i. PHYS 114/117, PHYS 121 or PHYS 210; PHYS 115/118, PHYS 122, or PHYS 211 (required)
    - ii. PHYS 116/PHYS 119, PHYS 123, or PHYS 212 (optional)

Program Requirements: (105 credits)

1. Basic Mathematics and Science (50-60 credits): minimum of 15 credits in two of the below fields (10 credits if taking honors chemistry and math) and a minimum of 10 credits in each of the remaining three fields.
    a. Biology:
        i. BIOL 180; BIOL 200 (required)
        ii. BIOL 220 (optional)
    b. Chemistry:
        i. CHEM 142/CHEM 144/CHEM 145; CHEM 152/CHEM 154/CHEM 155 (required)
        ii. CHEM 162/CHEM 164 (optional)
    c. Earth and Space Science:
        i. ESS 211; ESS 213 (required)
        ii. ESS 205 or ESS 212 (optional)
    d. Mathematics:
        i. MATH 124 or MATH 134; MATH 125 or MATH 135 (required)
            Note: Q SCI 291; Q SCI 292 (Pending).
        ii. MATH 126, MATH 136, Q SCI 381, or STAT 311 (optional)
    e. Physics:
        i. PHYS 114/117, PHYS 121 or PHYS 210; PHYS 115/118, PHYS 122, or PHYS 211 (required)
        ii. PHYS 116/PHYS 119, PHYS 123, or PHYS 212 (optional)

2) Disciplinary Track (18-19 credits):
    a. Astronomy (minimum of 18 credits):
        i. ASTR 321, ASTR 322, ASTR 323; 9 additional credits of approved ASTR or PHYS courses.

    b. Atmospheric Science (minimum of 18 credits):
        i. ATM S 301; 13 additional credits from ATM S 321, ATM S 340, ATM S 341, ATM S 358, ATM S 370, or ATM S 431.

    c. Biology (minimum of 18 credits):
        i. Two of BIOL 350, BIOL 354, BIOL 355, BIOL 356; 12 additional credits of approved 300-400 level BIOL courses.

    d. Chemistry (minimum of 19 credits):
        i. One of the following sequences: CHEM 237, CHEM 238, CHEM 239 or CHEM 335, CHEM 336, CHEM 337; remaining credits from CHEM 241 or CHEM 346, CHEM 242 or CHEM 347, CHEM 165 or CHEM 312, CHEM 436, CHEM 452, CHEM 453, CHEM 455, CHEM 456, BIOC 405, and BIOL 406; minimum of two courses taken in residence at the UW.

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

f. Oceanography (minimum 18 credits):
    i. OCEAN 200, OCEAN 201; OCEAN 220; one of OCEAN 400, OCEAN 410, OCEAN 420, or OCEAN 430; 3 credits of approved 300-400 level OCEAN courses; 3 credits of approved 400-level OCEAN courses.

g. Physics (minimum of 18 credits):
    i. PHYS 224; PHYS 231; PHYS 248; PHYS 334; two of PHYS 335, PHYS 431, PHYS 433, or PHYS 434; or one course from above plus PHYS 407, PHYS 408, or PHYS 409.

3) Science Research (6 credits):
    a. 6 credits from ASTR 499, ATM S 499, BIOL 499, CHEM 499, ESS 499, OCEAN 499, PHYS 499, or other approved undergraduate research course.

4) Integrated Sciences core (**21** credits):
    a. INTSCI 401 (2); INTSCI 402 (5); INTSCI 403 (5); INTSCI 491 (**2**); INTSCI 492 (**4**); INTSCI 493 (**3**).

5) Minimum grade of 2.0 in courses applied to the major.

Notes:

1) Students choosing the Biology, Chemistry, or Earth and Space Science tracks must take 15 credits in that discipline as part of the Basic Science and Mathematics course requirement. (10 credits for CHEM 145/155)
2) Students choosing the Astronomy, Atmospheric Sciences, or Physics tracks must take MATH 126 and PHYS 121, PHYS 122, PHYS 123 (or PHYS 210, PHYS 211, PHYS 212) as part of the Basic Science and Mathematics course requirement.

Bachelor of Science in Integrated Sciences
Degree Proposal (Revised)
May 17, 2011

Introduction
The College of Arts and Sciences at the University of Washington proposes a new Bachelor of Science degree in Integrated Sciences. The new degree is motivated by the recognition that existing science degrees do not optimally serve the needs of UW undergraduates who are interested in teaching careers at the middle and high school levels or who are interested in careers in informal education (e.g., at museums, science centers), science writing, science policy, technical management, or technology law. For these workplaces and careers, experience in multiple science disciplines is essential training. For example, few secondary teachers can focus their classroom instruction solely on a single science specialty; teaching biology may require knowledge of geology and atmospheric science. Furthermore, contemporary societal problems, such as global warming, pollution, population pressures, or disease prevention and control, can be evaluated or addressed only by integrating knowledge from scientific fields spanning both biological and physical sciences. A perspective broader than that of a single discipline is a necessity for science teaching and other science professions.

The proposed degree program is both interdisciplinary and rigorous. It begins with a grounding in the foundations of mathematics, biology, chemistry, physics, and the earth and space sciences. Additional upper-division courses in a particular discipline ensure that students have studied a particular science in depth. What is most innovative about, and essential to, the degree is a sequence of new courses that cut across specific scientific disciplines, as much of contemporary research at UW does. These courses, described below, will provide students with a unique experience of the practice and methodology of modern science.

- Seminar: The seminar will include participation in formal and informal science education settings with subsequent reporting; presentations by science educators; and reading and discussing research articles on science education and communication.

- Nature of Science: 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?

- Science in Context: 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.

- Integrated Sciences Capstone: An intensive "hands-on" science experience that begins with a class in which students learn to develop a research proposition; continues with data collection and analysis through modeling and interpretation under the supervision of a faculty mentor; a parallel class in which majors discuss and reflect on their research experiences; and a final class focusing on communication using both written and an oral products. Work that crosses disciplinary boundaries is encouraged.

The emphasis within this program on the "Nature" and "Practice" of science will also provide a continuing stimulus within existing academic units for review and improvement of undergraduate curriculum for all science students.

Program Description and Curriculum

The Integrated Sciences program gives students the opportunity to explore a broad spectrum of physical, life, and earth sciences. Such breadth will benefit those interested in careers that require a broad technical background, such as science education or science policy, since few contemporary world challenges can be addressed within the confines of a single scientific discipline. The basic science and mathematics courses establish a foundation in mathematics, biology, chemistry, physics, and the earth and space sciences. Disciplinary track courses ensure depth in a particular scientific discipline. In addition, the degree emphasizes the nature and practice of science, providing an opportunity for students to reflect on science as a human endeavor and to develop knowledge and skills necessary for scientific inquiry.

Degree Program Admission Requirements: The Integrated Sciences program offers admission 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. Since eligible applicants exceed the space available, acceptance is competitive. 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 the promise of achievement in a science or science education career.

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.

Students must present a minimum of 45 academic credits at the time of application from the Basic Science and Mathematics courses listed below, with a minimum of 15 credits in each of two fields and a minimum of 10 credits from the remaining three fields.

Degree Program Grade Requirement: A minimum grade of 2.0 is required in each graded course applied to meet the requirements of the Integrated Sciences degree. 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 with impeccable scientific credentials. 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. All Integrated Sciences majors must create an academic plan with an Integrated Sciences academic advisor. The academic plan maps which quarter students take courses to ensure timely completion of degree requirements. A copy of the approved academic plan is kept on file at the Integrated Sciences offices.

2. Students must communicate with an Integrated Sciences academic advisor to approve a revised and updated academic plan when withdrawing from courses required for the degree.

3. Students must review their academic plan with an Integrated Sciences academic advisor for approval at least once per academic year.

4. 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 how 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.

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, ESS 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 for students choosing the Biology disciplinary track. [Under consideration.]

DISCIPLINARY TRACK COURSES

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.

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 Oceanography track should consult with the program advisor regarding the selection of Basic Science and Mathematics courses.

INTEGRATED SCIENCES CORE COURSES [12 credits]

2 credits	INTSCI 401, Seminar/Clinic (to be taken twice)
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, C/NC
4 credits	INTSCI 492, Reflections on Research, C/NC (to be taken twice)
3 credits	INTSCI 493, Communicating Research
6 credits	ASTR 499, ATM S 492, BIOL 499, CHEM 499, ESS 499, OCEAN 499, PHYS 499, or other approved undergraduate research course, C/NC

New Integrated Sciences core courses:

INTSCI 401 Seminar/Clinic (1 credit, max 2)

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 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.

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 seven 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 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 401		
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 (Program/astro.) (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 401		
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 401		
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 401		
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 401		
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 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 401		
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 401		
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

Background to and Justification of Degree Program

An Integrated Sciences Degree Committee was appointed in January 2006 by the Divisional Dean of Natural Sciences in the College of Arts and Sciences to investigate the need for an undergraduate Integrated Sciences major at the University of Washington. Impetus for constituting this committee came both from the College of Arts and Sciences and from the leadership of UW's Teachers for a New Era project, funded by the Carnegie Corporation of New York. Committee membership included faculty from UW Departments of Astronomy, Atmospheric Sciences, Biology, Chemistry, Curriculum and Instruction, Earth and Space Sciences, Mathematics, Physics, and Technical Communication. Other committee members included a middle school science teacher, a school district science supervisor, and two museum professionals who were deeply involved in professional development for educators. As discussed below, the committee soon recognized the need for a new degree in Integrated Sciences.

The program proposed here is based on the efforts of that committee and subsequent discussions with curriculum committees in the Departments of Astronomy, Atmospheric Sciences, Biology, Chemistry, Earth and Space Sciences, and Physics, as well as in consultation with staff who work on general curriculum approval at the university. (Through most of the development of this program, the six listed departments were part of the College of Arts and Sciences. More recently, Atmospheric Sciences and Earth and Space Sciences joined the newly formed College of the Environment.) After a lull, a new committee was formed in September 2010, at the request of the Dean of Arts and Sciences, in order to complete the process of establishing an Integrated Sciences degree program.

In analyzing the potential need for and benefits of the proposed degree program, Integrated Sciences committees considered four key questions:

1. *Are there existing models of Integrated Sciences degrees at other colleges or universities that might guide consideration of an Integrated Sciences degree appropriate for UW undergraduates?*

What was found was that a number of universities have general science endorsements for education majors. Others offer Integrated Sciences programs either to meet education major needs or as an alternative to a straight disciplinary degree. However, none of these programs are genuinely integrated in the sense of the program proposed here. In particular, they lack specific courses or experiences designed to address questions concerning the nature and practice of science. Such courses are the centerpiece of the proposed degree, which would provide a program unique to the State of Washington.

2. *For science majors who enter the Master's degree program for secondary science teacher preparation in the College of Education at UW, what are the strengths and weaknesses of their undergraduate science preparation?*

College of Education faculty have found in their research that students entering the UW Science Education Masters program have strong content knowledge in their major field; that is, they know the facts and can solve problems. However, many are lacking in their understanding of science inquiry: how to conduct an investigation or how evidence is used in relationship to hypothesis, theory, and scientific argument. They have difficulty identifying big ideas and recognizing how ideas are integrated with one another. Students completing the proposed degree would enter teacher preparation programs and embark on teaching careers without such gaps.

3. *What do in-service teachers perceive as strengths and weaknesses of their preparation to become science teachers?*

Several members of the original Integrated Sciences committee had on-going projects in schools, ran teacher workshops, or had daily contact with teachers as part of their jobs in school districts. In addition, several local science teachers attended a committee meeting. It was thus possible for the committee to conduct an informal survey of about 65 in-service middle and high school science teachers regarding their backgrounds and experiences.

Almost all of the teachers interviewed wished they had more breadth in their undergraduate science education. Many, even though they may have obtained degrees in a single science discipline, were required to broaden the repertoire of subjects they taught because of the needs of their school or district. Typical examples are a high school chemistry teacher asked to teach biology; a biology teacher teaching a 10th grade general science course that encompasses earth and space science; and a middle school science teacher encountering many different combinations of sciences (typically at least three are taught in a year), combinations that can change radically if the teacher is switched to a different grade level.

Washington State Grade Level Expectations focus partly on facts and concepts, but also include a component consisting of issues of science process, such as what a system is, how to conduct an investigation, and what constitutes valid evidence. Many teachers reported that, in retrospect, their undergraduate training did not provide adequate tools to teach science process to their students. They thought more time for consideration of and reflection on the principles of science would have served them better.

Students who complete the integrated sciences degree will have the background and skills identified in the survey as needed by science teachers, thanks to the program's innovative new courses and capstone experience, as well as the breadth of study required.

4. *When do in-service teachers make the decision to become science teachers?*

Through the teacher survey, it was found that teachers rarely came to college expecting to become educators. Some decided to become classroom teachers late in their undergraduate studies. Others decided to pursue education after completing a degree. Still others entered teaching as a second career. Implicit in their responses was the recognition that career opportunities in science teaching and the path from a science bachelor's degree to teaching credentials are not always effectively communicated to undergraduate science majors.

The Integrated Sciences degree, by design, will meet the needs of undergraduates preparing for careers as science teachers, providing them with a path from an undergraduate science degree to a teaching career. Moreover, students will be able to learn about the Integrated Sciences program in multiple ways: from the website, through advisors in science and mathematics departments and across campus, from science and mathematics faculty. Program staff will set up an on-going outreach effort to make faculty, staff, and students aware of the program.

The degree in Integrated Sciences proposed in this document has multiple benefits for the university community and for the state. As has been discussed already in detail, the program will provide better educational opportunities for future secondary science teachers, who will acquire needed breadth as well as intellectual tools and resources to better understand science. This will inevitably benefit not just the teachers themselves but also their future students. Furthermore, by creating a visible career path in science education, the degree will increase the number and improve the quality of science teachers.

The idea for the Integrated Sciences degree arose in the context of UW's Teachers for a New Era initiative, which had as one of its goals increased cooperation between faculty in the College of Education and disciplinary faculty in departments of the College of Arts and Sciences (and also, now, the College of the Environment), as well as cooperation between faculty and local school districts. The process of program development has itself relied on such cooperation. If approved, the program will continue to serve as a bridge between these groups.

The Integrated Sciences degree is by no means a degree for future teachers only. It has been designed to meet the needs of students anticipating a wide variety of science-based careers, such as informal science education, science writing, science policy, and science and technology law. In addition, the degree will be a good choice for students preparing to attend medical school, law school, or Master's programs in public policy. 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.

One additional impact of the degree will arise from its bringing together faculty from the various science departments to teach and mentor students in the program. In recent years, faculty throughout the university's science departments have been re-thinking how to engage students more actively in learning, from student experiences in large introductory courses to upper-level courses and research. As well, faculty have been developing programs focused on emerging interdisciplinary areas of science and technology. The integrated sciences program will provide additional opportunities for faculty to learn from each other about best practices for teaching and to emphasize, in their courses, the broader impact of science and the nature and practice of science.

An important component of the degree program will be on-going assessment. Assessment of the new 400-level courses will rely at first on student and collegial evaluations, allowing the instructors to refine the courses. Once the courses have matured, the Integrated Sciences steering committee will evaluate how well they meet the goals of the program, perhaps in collaboration with university assessment consultants. 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 perhaps two and five years after graduation.

INTSCI 491, 492, 493

INTSCI 491 Introduction to Research – Designing and Developing a Research Project

Syllabus

2 credits, one 1.5 hrs./wk. prep. 5 hrs./week (taken one time) A, W, Sp

Based on 10-week quarter, to be taken before beginning departmental 499 research/credit or concurrent with first quarter of departmental 499 research/credit

1. What is scientific research?

    - Research and the Scientific Method

2. Why do scientific research? What are the expected outcomes?

    - Basic and Applied or Focused Research

3. How do I prepare a suitable research project and locate a research laboratory? Do I need to obtain funding?

    - Faculty Research – What is suitable for me?
    - Develop a research agreement
    - On- and Off-Campus Funding Sources

4. What will the research product look like?

    - Research Proposals and Results
    - Examples of Research Proposals

5. How do I develop a research proposal/project?

    - Literature Review
    - Rationale
    - Statement of Problem and Research Questions
    - Objectives
    - Methods and Design of Proposal/Project
    - Data Analysis
    - Budget and Logistics

6. Work on research proposal – I

    - Work Individually
    - Outline basic components of research project*

7. Work on research proposal - II

- Work in groups
  - Introduction
  - Rationale
  - Objectives
  - Methods and Design
  - Data Analysis
  - Logistics

8. Work on research proposal - III

- Work in groups
  - Budget
  - Outcomes/Results
  - Impact and Application of Results

9. Presentation of research proposals - I

- Student presentations
- Feedback

10. Presentation of research proposals - II

- Student presentations
- Feedback

References:

1. http://www.columbia.edu/cu/biology/ug/research/paper.html

2. http://www.rxpgonline.com/article1745.html

3. http://lrs.ed.uiuc.edu/tse-portal/proposal/dan-ryan-proposal/propweb.htm

4. http://peace-foundation.net.7host.com/file/sheldon%20l%20glashow.pdf

5. http://www.sc.edu/our/doc/Proposaltipshints.pdf

6. http://www.cmu.edu/uro/SURF/proposal.html

*7. Typical components of a research proposal:

Abstract
Background: Problem identification, problem definition and problem justification

Goals and objective
Research questions and hypothesis
Study design
Methods
Analysis plan
Plan for interpretation
Plan for dissemination
Logistics
Work schedule
Bibliography
Appendices

INTSCI 492 – The Research Process – Management and Discussion of Research Projects

Syllabus

2 credits, one 1.5 hrs./wk. prep. 5 hrs./week (taken two times), A, W, Sp

Based on 10-week quarter, concurrent enrollment in departmental 499 research experience/credits

1. Working as a team – student, departmental researcher and course instructor

    - Lab meetings
    - Class meetings

2. Establishing and Maintaining a Realistic Timetable and Research Schedule

3. On-going Research Projects

    - Experimental design

4. Recording and Analyzing data

    - Lab and Field Note Books

5. Short Presentations and Discussion - I

6. Short Presentations and Discussion - II

7. Results and Presentation of Data

8. Short Presentations and Discussion – I

9. Short Presentations and Discussion - II

10. Discussion - Bringing together the Loose Ends

References:

1. Hunt, A. 2005. Your Research Project: How to Manage It. Routledge Study Guides.

INTSCI 493 Communicating Research Findings – Relationship and Relevance to Science, Education and Society

Syllabus

3 credits, two, 2 hrs./wk. prep. 7 hrs./week (taken two times), A, W, Sp

Based on 10-week quarter, build from 499 research experience

1. Who does the research belong to: Student, Researchers, Principal Investigator, Scientific Journal, University?

- Discoveries, Patents, Copyrights, etc.

2. Presentation of Data – journal article, book chapter, etc.

- Publication of scientific papers -
  - Reviewed Publications
  - Non-Review Publications

3. Presentation of Data - poster, oral presentation,

- Posters – Presentation

- Oral Presentations – Meetings, Classroom, etc.

4. Relating INTSCI Course Work to Research and Learning

5. Research and Integrated Science – Costs and Benefits!

6. Research, Science and Society - What are the connections?

7. Student Presentations - I

8. Student Presentations - II

9. Student Presentations - III

10. Student Presentations - IV

References:

1. http://umech.mit.edu/freeman/6.021J/2000/writing.pdf

2. http://www.columbia.edu/cu/biology/ug/research/paper.html

3. http://www.swarthmore.edu/NatSci/cpurrin1/posteradvice.htm

4. http://www.youtube.com/watch?v=MqgjgwIXadA

5. http://www.cs.washington.edu/homes/mernst/advice/giving-talk.html

6. http://faculty.washington.edu/scporter/INQUAposters.html

7. http://www.washington.edu/research/urp/symp/posterparticipants.html

Bachelor of Science in Integrated Sciences
Degree Proposal
April 1, 2011

Introduction
The College of Arts and Sciences at the University of Washington proposes a new Bachelor of Science degree in Integrated Sciences. The new degree is motivated by the recognition that existing science degrees do not optimally serve the needs of UW undergraduates who are interested in teaching careers at the middle and high school levels or who are interested in careers in informal education (e.g., at museums, science centers), science writing, science policy, technical management, or technology law. For these workplaces and careers, experience in multiple science disciplines is essential training. For example, few secondary teachers can focus their classroom instruction solely on a single science specialty; teaching biology may require knowledge of geology and atmospheric science. Furthermore, contemporary societal problems, such as global warming, pollution, population pressures, or disease prevention and control, can be evaluated or addressed only by integrating knowledge from scientific fields spanning both biological and physical sciences. A perspective broader than that of a single discipline is a necessity for science teaching and other science professions.

The proposed degree program is both interdisciplinary and rigorous. It begins with a grounding in the foundations of mathematics, biology, chemistry, physics, and the earth and space sciences. Additional upper-division courses in a particular discipline ensure that students have studied a particular science in depth. What is most innovative about, and essential to, the degree is a sequence of new courses that cut across specific scientific disciplines, as much of contemporary research at UW does. These courses, described below, will provide students with a unique experience of the practice and methodology of modern science.

- Seminar: The seminar will include participation in formal and informal science education settings with subsequent reporting; presentations by science educators; and reading and discussing research articles on science education and communication.

- Nature of Science: 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?

- Science in Context: 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.

- Integrated Sciences Capstone: An intensive "hands-on" science experience that begins with a class in which students learn to develop a research proposition; continues with data collection and analysis through modeling and interpretation under the supervision of a faculty mentor; a parallel class in which majors discuss and reflect on their research experiences; and a final class focusing on communication using both written and an oral products. Work that crosses disciplinary boundaries is encouraged.

The emphasis within this program on the "Nature" and "Practice" of science will also provide a continuing stimulus within existing academic units for review and improvement of undergraduate curriculum for all science students.

Program Description and Curriculum

The Integrated Sciences program gives students the opportunity to explore a broad spectrum of physical, life, and earth sciences. Such breadth will benefit those interested in careers that require a broad technical background, such as science education or science policy, since few contemporary world challenges can be addressed within the confines of a single scientific discipline. The basic science and mathematics courses establish a foundation in mathematics, biology, chemistry, physics, and the earth and space sciences. Disciplinary track courses ensure depth in a particular scientific discipline. In addition, the degree emphasizes the nature and practice of science, providing an opportunity for students to reflect on science as a human endeavor and to develop knowledge and skills necessary for scientific inquiry.

Degree Program Admission Requirements: competitive. To apply for admission to the program, students must have completed 45 credits of Basic Science and Mathematics Courses, as listed below, with a minimum grade of 2.0 in each course and a grade point average of 2.5 or above in the courses as a whole. It is anticipated that any student meeting these requirements will be admitted until the overall cap on the number of students enrolled in the program is reached. The cap will initially be set at 50 majors altogether, with admission staggered initially to reach this number over two years, so that the demands on the program can be met with the available resources. Given sufficiently large demand and resources, this cap will be increased. Should demand significantly exceed space available, a more formal admissions process will be developed, with applicants asked to provide a personal statement explaining their interest in the program and any relevant experiences beyond course work and with applications reviewed by a subcommittee of the Integrated Sciences Steering Committee.

Degree Program Grade Requirement: A minimum grade of 2.0 is required in each graded course meeting the requirements of the Integrated Sciences degree. A grade point average of 2.5 or above is required for the graded courses meeting the requirements of the degree.

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	MATH 124, 125 (required) MATH 126 (optional) STAT 311 or equivalent (optional)
10-15 credits	BIOL 180, 200 (required) BIOL 220 (optional)
10-15 credits	CHEM 142, 152 (required) CHEM 162 (optional)
10-15 credits	ESS 210 or 211, ESS 213 (required) ESS 205 or 212 (optional)
10-15 credits	PHYS 114/117, 115/118 or PHYS 121, 122 or PHYS 210, 211 (one of the three options is required) PHYS 116/119 or PHYS 123 or PHYS 212 (optional)

DISCIPLINARY TRACK COURSES [15 credits from one of the tracks below.]

Astronomy Track

15 credits	ASTR 321, 322, 323 and 6 credits of approved astronomy or physics courses. Prospective teachers are encouraged to take ASTR 500.

Atmospheric Sciences Track

15 credits	ATM S 301; an additional 10 credits from ATM S 321, 340, 341, 358, 370, 431.

Biology Track

15 credits	Two courses selected from BIOL 350, 354, 355, 356; an additional 9 credits from approved upper level (3xx or 4xx) course work in biological sciences. BIOL 492A is recommended for teachers.

Chemistry Track

15 credits	15 credits selected from CHEM 237, 238, 239, 241, 242, or 312.

Earth & Space Sciences Track

15 credits	Two courses selected from ESS 311, 312, 313, 314, 315; a third selected from this same list or from a list of approved 400-level courses.

Physics Track

15 credits	PHYS 224, 231, 248, 334 and one of PHYS 335, 431, 433, 434 (non-teacher track), or PHYS 407, 408, 409 (recommended for teachers).

Note: 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. 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.

INTEGRATED SCIENCES CORE COURSES [12 credits]

2 credits	INTSCI 401, Seminar/Clinic (to be taken twice) — to be created
5 credits	INTSCI 402, Nature of Science — to be created
5 credits	INTSCI 403, Science in Context — to be created

INTEGRATED SCIENCES CAPSTONE COURSES [10 credits]

1 credit	INTSCI 491, Introduction to Research, C/NC — to be created
1 credit	INTSCI 492, Reflections on Research, C/NC — to be created
2 credits	INTSCI 493, Communicating Research — to be created
6 credits	Science department research (499 or other suitable course), C/NC

New Integrated Sciences core courses:

INTSCI 401 Seminar/Clinic (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 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 (1 credit)

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 (1 credit)

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 (2 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.

Background to and Justification of Degree Program

An Integrated Sciences Degree Committee was appointed in January 2006 by the Divisional Dean of Natural Sciences in the College of Arts and Sciences to investigate the need for an undergraduate Integrated Sciences major at the University of Washington. Impetus for constituting this committee came both from the College of Arts and Sciences and from the leadership of UW's Teachers for a New Era project, funded by the Carnegie Corporation of New York. Committee membership included faculty from UW Departments of Astronomy, Atmospheric Sciences, Biology, Chemistry, Curriculum and Instruction, Earth and Space Sciences, Mathematics, Physics, and Technical Communication. Other committee members included a middle school science teacher, a school district science supervisor, and two museum professionals who were deeply involved in professional development for educators. As discussed below, the committee soon recognized the need for a new degree in Integrated Sciences.

The program proposed here is based on the efforts of that committee and subsequent discussions with curriculum committees in the Departments of Astronomy, Atmospheric Sciences, Biology, Chemistry, Earth and Space Sciences, and Physics, as well as in consultation with staff who work on general curriculum approval at the university. (Through most of the development of this program, the six listed departments were part of the College of Arts and Sciences. More recently, Atmospheric Sciences and Earth and Space Sciences joined the newly formed College of the Environment.) After a lull, a new committee was formed in September 2010, at the request of the Dean of Arts and Sciences, in order to complete the process of establishing an Integrated Sciences degree program.

In analyzing the potential need for and benefits of the proposed degree program, Integrated Sciences committees considered four key questions:

1. *Are there existing models of Integrated Sciences degrees at other colleges or universities that might guide consideration of an Integrated Sciences degree appropriate for UW undergraduates?*

What was found was that a number of universities have general science endorsements for education majors. Others offer Integrated Sciences programs either to meet education major needs or as an alternative to a straight disciplinary degree. However, none of these programs are genuinely integrated in the sense of the program proposed here. In particular, they lack specific courses or experiences designed to address questions concerning the nature and practice of science. Such

courses are the centerpiece of the proposed degree, which would provide a program unique to the State of Washington.

2. *For science majors who enter the Master's degree program for secondary science teacher preparation in the College of Education at UW, what are the strengths and weaknesses of their undergraduate science preparation?*

College of Education faculty have found in their research that students entering the UW Science Education Masters program have strong content knowledge in their major field; that is, they know the facts and can solve problems. However, many are lacking in their understanding of science inquiry: how to conduct an investigation or how evidence is used in relationship to hypothesis, theory, and scientific argument. They have difficulty identifying big ideas and recognizing how ideas are integrated with one another. Students completing the proposed degree would enter teacher preparation programs and embark on teaching careers without such gaps.

3. *What do in-service teachers perceive as strengths and weaknesses of their preparation to become science teachers?*

Several members of the original Integrated Sciences committee had on-going projects in schools, ran teacher workshops, or had daily contact with teachers as part of their jobs in school districts. In addition, several local science teachers attended a committee meeting. It was thus possible for the committee to conduct an informal survey of about 65 in-service middle and high school science teachers regarding their backgrounds and experiences.

Almost all of the teachers interviewed wished they had more breadth in their undergraduate science education. Many, even though they may have obtained degrees in a single science discipline, were required to broaden the repertoire of subjects they taught because of the needs of their school or district. Typical examples are a high school chemistry teacher asked to teach biology; a biology teacher teaching a 10th grade general science course that encompasses earth and space science; and a middle school science teacher encountering many different combinations of sciences (typically at least three are taught in a year), combinations that can change radically if the teacher is switched to a different grade level.

Washington State Grade Level Expectations focus partly on facts and concepts, but also include a component consisting of issues of science process, such as what a system is, how to conduct an investigation, and what constitutes valid evidence. Many teachers reported that, in retrospect, their undergraduate training did not provide adequate tools to teach science process to their students. They thought more time for consideration of and reflection on the principles of science would have served them better.

Students who complete the integrated sciences degree will have the background and skills identified in the survey as needed by science teachers, thanks to the program's innovative new courses and capstone experience, as well as the breadth of study required.

4. *When do in-service teachers make the decision to become science teachers?*

Through the teacher survey, it was found that teachers rarely came to college expecting to become educators. Some decided to become classroom teachers late in their undergraduate studies. Others decided to pursue education after completing a degree. Still others entered teaching as a second career. Implicit in their responses was the recognition that career opportunities in science teaching and the path from a science bachelor's degree to teaching credentials are not always effectively communicated to undergraduate science majors.

The Integrated Sciences degree, by design, will meet the needs of undergraduates preparing for careers as science teachers, providing them with a path from an undergraduate science degree to a teaching career. Moreover, students will be able to learn about the Integrated Sciences program in multiple ways: from the website, through advisors in science and mathematics departments and across campus, from science and mathematics faculty. Program staff will set up an on-going outreach effort to make faculty, staff, and students aware of the program.

The degree in Integrated Sciences proposed in this document has multiple benefits for the university community and for the state. As has been discussed already in detail, the program will provide better educational opportunities for future secondary science teachers, who will acquire needed breadth as well as intellectual tools and resources to better understand science. This will inevitably benefit not just the teachers themselves but also their future students. Furthermore, by creating a visible career path in science education, the degree will increase the number and improve the quality of science teachers.

The idea for the Integrated Sciences degree arose in the context of UW's Teachers for a New Era initiative, which had as one of its goals increased cooperation between faculty in the College of Education and disciplinary faculty in departments of the College of Arts and Sciences (and also, now, the College of the Environment), as well as cooperation between faculty and local school districts. The process of program development has itself relied on such cooperation. If approved, the program will continue to serve as a bridge between these groups.

The Integrated Sciences degree is by no means a degree for future teachers only. It has been designed to meet the needs of students anticipating a wide variety of science-based careers, such as informal science education, science writing, science policy, and science and technology law. In addition, the degree will be a good choice for students preparing to attend medical school, law school, or Master's programs in public policy. 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.

One additional impact of the degree will arise from its bringing together faculty from the various science departments to teach and mentor students in the program. In recent years, faculty throughout the university's science departments have been re-thinking how to engage students more actively in learning, from student experiences in large introductory courses to upper-level courses and research. As well, faculty have been developing programs focused on emerging interdisciplinary areas of science and technology. The integrated sciences program will provide additional opportunities for faculty to learn from each other about best practices for teaching and to emphasize, in their courses, the broader impact of science and the nature and practice of science.

An important component of the degree program will be on-going assessment. Assessment of the new 400-level courses will rely at first on student and collegial evaluations, allowing the instructors to refine the courses. Once the courses have matured, the Integrated Sciences steering committee will evaluate how well they meet the goals of the program, perhaps in collaboration with university assessment consultants. 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 perhaps two and five years after graduation.

ATMOS. SCI APPROVAL

From: Dale Durran <drdee@uw.edu>
Date: February 18, 2011 8:31:13 AM PST
To: Ron Irving <rsi@uw.edu>
Subject: Re: Integrated Sciences degree proposal
Reply-To: durrand@atmos.washington.edu

Dear Ron,

I am happy to sign off on behalf of Atmospheric Sciences. I will be out for a bit starting next Thursday.

Cheers,

Dale

Dale Durran
Professor and Chair
Atmospheric Sciences
Box 351640
University of Washington
Seattle, WA 98195

Phone (206) 543-7440 Fax (206) 543-0308
Email: drdee@uw.edu
http://www.atmos.washington.edu/~durrand/

ASTRONOMY APPROVAL

Kevin K. Mihata

From: Suzanne Hawley [slh@astro.washington.edu]
Sent: Thursday, March 31, 2011 5:18 PM
To: Ron Irving
Cc: Kevin K. Mihata
Subject: Re: Integrated Sciences

Categories: Integrated Sciences

Hi Ron,

Yes, Astronomy is on board. I hope Julie also mentioned that we have a new lecturer (Oliver Fraser) that we are hiring to work on our AST 101 online course, who would be great at running an ISP seminar or otherwise being involved in teaching in the ISP program. And his salary is pretty cheap!

- Suzanne

Suzanne Hawley
Chair, Astronomy Box 351580
University of Washington
Seattle, WA 98195
(206) 685 2236
slh@astro.washington.edu

On Thu, 31 Mar 2011, Ron Irving wrote:

> Suzanne,
>
> Julie Lutz assured me that the department approved the Astronomy disciplinary track and that you would sign off on it. I hope that's accurate. If it is, could you please respond to this email, to both Kevin and me, saying that you'll sign off? We're about to submit the proposal to FCAS and want to have evidence that the various departments involved said yes. Thanks.
>
> Ron

BIOLOGY APPROVAL

From: Raymond Huey <hueyrb@u.washington.edu>
Date: March 28, 2011 10:24:18 AM PDT
To: Ron Irving <rsi@uw.edu>
Cc: Joseph F Ammirati <cort@u.washington.edu>, Helen Buttemer <helenb@u.washington.edu>
Subject: Re: Integrated Sciences

Hi Ron

I've looked through the degree proposal and have talked with Joe about various issues. The bottom line is that I support the concept of the IS degree -- I think it has a useful place in our overall program and will serve the State of Washington. And so I sign off for Biology

I do have some minor concerns:

1) I cannot judge whether the course work in the disciplines will be sufficient for our graduates to pass the certification exam in that discipline. Presumably it will be, but the issue is worth raising.

2) If a Lecturer who has a 100% appointment in a given Department starts teaching part-time in IS (with IS buying out part of their salary), will the Lecturer maintain voting rights in the home department? [Voting rights are a sensitive issue.]

3) Many of our upper-division courses currently fill with our own majors, and thus IS students (who have lower priority) might have some challenges enrolling in such courses.

Again, I support the concept of the degree program. But funding remains an issue. As I mentioned in previous correspondence, I do question whether this is the time to implement this program, as funds dedicated to a new program in effect amplify the magnitude of budget cuts to existing programs. The key issue is whether the projected benefits from a new program are likely to be significantly greater than the induced costs to existing programs. I don't have the information to make that evaluation objectively, but as Chair, I would be hesitant to support implementation of program for non-majors if it hurts our own majors.

Ray

****

Raymond B. Huey, Professor & Chair
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CHEMISTRY APPROVAL

Kevin K. Mihata

From: Ron Irving [rsi@uw.edu]
Sent: Thursday, March 31, 2011 2:37 PM
To: Kevin K. Mihata
Subject: Fwd: Integrated Sciences degree proposal

Categories: Integrated Sciences

From: Paul Hopkins <chair@chem.washington.edu>
Date: February 17, 2011 4:44:47 PM PST
To: Ron Irving <rsi@u.washington.edu>
Subject: Re: Integrated Sciences degree proposal

Phil Reid and Mike Heinekey confirmed that they have studied your proposal, and are strongly supportive. That's all I need. I will sign. I will provide more quotations if it is judged helpful.

I will sign.

Paul

Kevin K. Mihata ESS APPROVAL

From: Robert Winglee [winglee@ess.washington.edu]
Sent: Thursday, March 31, 2011 3:01 PM
To: Ron Irving
Cc: Kevin K. Mihata
Subject: Re: Integrated Sciences Degree

Categories: Integrated Sciences

This is to confirm that ESS will sign off on the degree. The only problem we had which I hope Mike fixed was that the core course for ESS should be ESS210 and not our majors core course as they are presently filled to capacity.

Robert

****
Prof. Robert Winglee

Chair, Department of Earth and Space Sciences Director, Washington Space Grant Consortium
Johnson Hall, Rm 070 Univ. of Washington Seattle WA 98195-1310
Phone: 206-685-8160 Fax : 206-543-0489
****

On Thu, 31 Mar 2011, Ron Irving wrote:

> Dear Robert,
>
> I understand that back a month or more ago, ESS agreed to the ESS disciplinary track within the Integrated Sciences degree and you agreed to sign off on it. At least this is what Mike and Liz told me. I hope that's the case and I apologize for not following up sooner. We're about to submit the degree proposal to FCAS, so I'm checking in with you now.
>
> If you are prepared to sign off on the degree proposal, could you reply to this email (including Kevin as well as me) saying so? And if not, please let me know your concerns so we can discuss them further. Thanks.
>
> Sincerely,
>
> Ron
>

PHYSICS APPROVAL

Kevin K. Mihata

From: Ron Irving [rsi@uw.edu]
Sent: Thursday, March 31, 2011 2:41 PM
To: Kevin K. Mihata
Subject: Fwd: Integrated Sciences: revised Physics disciplinary track

Categories: Integrated Sciences

Then I got this. Implicit is that between the two emails, approval was granted.

From: Blayne Heckel <heckel@phys.washington.edu>
Date: March 29, 2011 8:54:47 AM PDT
To: Ron Irving <rsi@u.washington.edu>
Subject: Re: Integrated Sciences: revised Physics disciplinary track

Hello Ron,
Just replace the Physics track requirement for Phys. 225, to a requirement for Phys. 248 -- Modern Physics. Phys. 248 is our number for special topics courses -- we'll offer the class next autumn as Modern Physics and if we're happy with it, we'll give the Modern Physics course its own number in subsequent years.

best,
Blayne

Blayne,

> Kevin Mihata just wrote to me to say that the next FCAS deadline for new business is the beginning of April, so he has suggested that we should aim to get the final version of our proposal to FCAS by next week. Is it possible that you or the department's majors committee will know by next week how you would like us to revise the Physics disciplinary track in order to take into account the changes you're making in your courses and pre-requisites? If not, is there something you can suggest that we use as a placeholder that has some chance of being accurate, and that can be easily revised later as needed? I welcome any advice. Thanks.
>
> Sincerely,
>
> Ron

Hi Jennifer,

That's a good question, though the answer predates me. This is the original group that was formed way back when, so it was reformed. I don't know the exact history before that. I think the committee would definitely want to move forward (since we only have our PNOI through the end of the academic year, after two extensions), but if Ocean wanted to join later, I am sure that everyone would be happy to entertain that discussion. With the exception of Astro, the departments are potential core (in the general sense) subjects taught in high school, so that is probably part of it. But again, I don't know for sure.

We've got the proposal together and will bring it over today or Monday. We talked in committee about the other questions raised, and I can tell you what the committee said, and if it comes up in SCAP, you can let them know. Then if we need more back-and-forth, we can obviously do that.

1. On the ASTRO course, the committee (including the Astro people) felt like the absence of an intro astro course would not fit the core teaching mission – relatively deep science engagement, and because the program is not designed solely as a teaching degree, would not hurt teachers who may or may not need to take ASTRO 101, 150, etc. Again, more broadly, the committee simply felt that the intro ASTRO courses were not rigorous enough to form part of the core curriculum
2. On the Q SCI issue, the committee felt fairly strongly that MATH 124 was appropriate to the core goals of the program. I mentioned the issue you raised – that it would be possible that an ESS major, say, would come into INT SCI with Q SCI; would we want to make that person retake 124, etc. The committee felt that it depended on the performance in Q SCI, but agreed that some kind of petition process would be appropriate for such students. In general, I think the sentiment was that students who did "well" in Q SCI should not have to take 124, but that students who did not (say, for example, those who proceeded with a 1.0) would need some sort of remediation. Whether that would be taking 124 or 125, I doubt, but the feeling was that some sort of intervention would be appropriate, rather than simply passing those students through.
3. We had a fairly in-depth discussion of the GPA issue; the committee would like to advocate for the current requirement, in part because the reliance on courses across departments makes it difficult to coordinate across potentially variable grading practices. As above, we felt that a petition process would be the appropriate way to handle exceptions (e.g., someone who gets a 1.7 in their final course).

Hard to believe we're actually getting to the point of submitting this....

Kevin

From: Jennifer A. Payne
Sent: Thursday, March 31, 2011 11:48 AM
To: Kevin K. Mihata
Subject: Another question

Why was Oceanography excluded from the INTSCI major?

The UW Teacher Ed program under the Earth Science endorsement lists ESS, OCEAN, ASTR, or ATM S as suitable majors (and they are supposed to complete the major plus at least 1 course in each of the other areas for the endorsement).

The Oceanography major requires the same foundational science courses as the INTSCI (would need 1 additional ESS course).

I would understand if ESS and ATM S didn't have tracks (i.e. only and A&S major) - did OCEAN not want to participate?

Jennifer

Graduation Requirements

Minimum 180 credits, to include the following:

1. *Foundational Courses (55 credits):* PHYS 121, PHYS 122, PHYS 123 (or PHYS 114, PHYS 115, PHYS 116); MATH 124, MATH 125, MATH 126 (or Q SCI 291, Q SCI 292, Q SCI 381); CHEM 142, CHEM 152 (or CHEM 144, CHEM 154); BIOL 180, BIOL 200; one of ESS 210, ESS 211, ESS 212 ; and BIOL 161-BIOL 162 or BIOL 180, BIOL 200, BIOL 220
2. OCEAN 200, OCEAN 201, OCEAN 210, OCEAN 220, OCEAN 400, OCEAN 410, OCEAN 420, OCEAN 430, OCEAN 443, OCEAN 444 (35 credits)
3. 400-level oceanography coursework selected in the student's area of specialization, in consultation with a faculty adviser (6 credits).
4. Upper-division science, mathematics, or engineering, selected in the student's area of specialization, in consultation with a faculty adviser (20 credits)
5. Free electives to bring credit total to minimum 180.
6. Minimum 2.0 grade in all required oceanography courses.

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