

COVER SHEET
NEW DEGREE PROGRAM PLANNING NOTIFICATION OF INTENT
(PLANNING NOI)

Program Information

Program Name: Mathematics

Institution Name: University of Washington Bothell

Degree Granting Unit: University of Washington Bothell
(e.g. College of Arts and Science)

Degree: B.S. Mathematics Level: Bachelor Type: Science
(e.g. B.S. Chemistry) (e.g. Bachelor) (e.g. Science)

Major: Mathematics CIP Code: 27.0101
(e.g. Chemistry)

Minor: _____
(if required for major)

Concentration(s):
(if applicable)

Proposed Start Date: 2013

Projected Enrollment (FTE) in Year One: 15-20 At Full Enrollment by Year: 25 - 30 FTE by 2015
(# FTE) (# FTE)

Proposed New Funding: \$250,000

Funding Source: State FTE

Mode of Delivery

Single Campus Delivery Bothell
Off-campus Delivery _____
Distance Delivery _____

Substantive Statement of Need (attached)

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Endorsement by Chief Academic Officer

September 15, 2011
Date

Mathematics

Substantive Statement of Need

June 2011

University of Washington Bothell

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I. Degree Program Description and Rationale

The University of Washington Bothell proposes to offer a Bachelor of Science degree in Mathematics.

Mathematics is an established and growing field with students pursuing careers in engineering, actuarial science, database and computer systems administration, network and data communication analysis, statistical analysis, secondary mathematics teaching, and other fields. Additionally, many students with a major in mathematics pursue graduate study in mathematics, physics, engineering, and other areas of study.

While the proposed curriculum represents a standard mathematics degree, the courses offered also reflect the recommendations put forth by the Mathematical Association of America's (MAA) *CUPM Curriculum Guide 2004* for majors preparing to be secondary mathematics teachers. According to MAA, mathematical sciences majors preparing to teach secondary mathematics should:¹

- *Learn to make appropriate connections between the advanced mathematics they are learning and the secondary mathematics they will be teaching. They should be helped to reach this understanding in courses throughout the curriculum and through a senior-level experience that makes these connections explicit.*
- *Fulfill the requirements for a mathematics major by including topics from abstract algebra and number theory, analysis (advanced calculus or real analysis), discrete mathematics, geometry, and statistics and probability with an emphasis on data analysis;*
- *Learn about the history of mathematics and its applications, including recent work;*
- *Experience many forms of mathematical modeling and a variety of technological tools, including graphing calculators and geometry software.*

II. Relationship to Institutional and Unit Priorities

"There are things which seem incredible to most men who have not studied mathematics." -Aristotle

A. Mission of University of Washington Bothell

The University of Washington Bothell Mission Statement includes, "UW Bothell holds the student-faculty relationship to be paramount. We provide access to excellence in higher education through innovative and creative curricula, interdisciplinary teaching and research, and a dynamic community of multicultural learning." The proposed degree in Mathematics supports the mission by presenting an intentional program informed through an interdisciplinary process.

¹ Mathematical Association of America (2004). Undergraduate Programs and Courses in the Mathematical Sciences: CUPM Curriculum Guide 2004. Ret May 2011: http://www.maa.org/cupm/curr_guide.html.

The process began in 2006 with the Applied Science and Technology Planning Committee Phase I Report, [PDF]. September 2006, Vice Chancellor of Academic Affairs Thomas Bellamy formed the Applied Science and Technology Planning (ASTP) group to make recommendations regarding future applied science, science, and technology programs at UW Bothell. The report identified potential programs through analysis of regional workforce needs, student demand and interest, and successful programs elsewhere. Phase 1 was followed by the STEM Task Force appointed by Vice Chancellor Susan Jeffords in January 2008 to make recommendations regarding future growth in science, technology, engineering and mathematics fields (STEM) at UW Bothell, [PDF]. In January 2011 the Mathematics and Quantitative Reasoning Task Force (MQRTF) was charged to consider how UW Bothell moves forward initiatives for mathematics and quantitative reasoning across the curriculum. The outcome is the realization of a Mathematics degree that demonstrates the following tenets from UW Bothell's mission:

- *Emphasize and develop critical thinking, writing, and information literacy, in order to graduate students with life-long learning skills.*
- *Actively recruit and support outstanding faculty scholars with a passion for communication.*
- *Build an inclusive and supportive community of learning and incorporate multicultural content and diverse perspectives on ethnic and racial groups, gender, sexual orientation, social class, and special needs.*

B. Strategic Plan

The 21st Century Initiative establishes seven priorities for the University of Washington Bothell through the year 2020. Growth as a priority states, "Serve the citizens of the State of Washington by providing access to a premier university education.", and places special emphasis on developing new degree programs that respond to the economic development needs of the state and region and to demographic changes. The areas of Science, Technology, Engineering and Math (STEM) were identified as top priorities for immediate growth.² The proposed degree supports identified priorities and will be housed in the Science and Technology Program. It will emphasize UW Bothell's strength in collaborative scholarship by extending curriculum that supports education, engineering, and technology.

III. Demand

"In this changing world, those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. Mathematical competence opens doors to productive futures." - National Council of Teachers of Mathematics

² UW Bothell (July 2008). The 21st Century Campus Initiative: University of Washington Priorities Plan 2008-2020. Retrieved March 2010, <http://www.uwb.edu/21stcentury/>.

The national perspective holds that U.S. must improve student performance in Science and Math to compete in a global economy. It was reported in 2010, that U.S. ranked 25th out of 34 Organization for Economic Cooperation & Development (OECD) countries in math testing among fifteen-year-olds.³ The Department of Education uses the Trends in International Mathematics and Science Study (TIMSS) to determine performance in mathematics and science achievement of U.S. 4th- and 8th-grade students compared to that of students in other countries. The TIMSS report shows gradual improvement since 1995 in U.S. students.⁴ Foremost, however, is the fact that we must commit resources and increase opportunities for STEM education if we want to produce an educated citizenry who can contribute to the welfare of the nation.

A. National Demand

Mathematics is a STEM discipline and is recognized as a field where immediate production in graduates is needed both nationally and regionally. Graduates can pursue advanced education in numerous disciplines and various career paths. Some common fields in which mathematicians study and find work are computer science and software development, physics, engineering, and operations research.⁵ Thus, demand is also spurred by rapid advances in technology. The following table conveys projected national demand in several occupations that require mathematics or education with rigorous mathematics requirements.

| Occupational Title | Employment | Projected Empl | Change, 2008-18 | |
|--|------------|----------------|-----------------|---------|
| | 2008 | 2018 | Number | Percent |
| Mathematicians | 2,900 | 3,600 | 700 | 22 |
| Actuaries | 19,700 | 23,900 | 4,200 | 21 |
| Database administrators | 120,400 | 144,700 | 24,400 | 20 |
| Network and computer systems administrators | 339,500 | 418,400 | 78,900 | 23 |
| Network systems and data communications analysts | 292,000 | 447,800 | 155,800 | 53 |
| Operations research analysts | 63,000 | 76,900 | 13,900 | 22 |
| Statisticians | 22,600 | 25,500 | 2,900 | 13 |

Table 1: OES - Occupations for Mathematics⁶

The percent change column reveals faster than average growth for all positions and ONet reports the outlook as “bright” for these occupations.⁷ This is a only partial listing of occupations as noted in OES data for educators/teachers was aggregated and is not included in the table but the demand for STEM educators at all level is strong.

³ John Hechinger (2010). U.S. Teens Lag as China Soars on International Test. Retrieved May 2011, <http://www.bloomberg.com/news/2010-12-07/teens-in-u-s-rank-25th-on-math-test-trail-in-science-reading.html>.

⁴ National Center for Education Statistic (2010). Special Analysis 2009. Retrieved April 2011, <http://nces.ed.gov/programs/coe/2009/analysis/>.

⁵ Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook (OOH), 2010-11 Edition, Mathematicians, Retrieved May 2011, <http://www.bls.gov/oco/ocos043.htm>).

⁶ Bureau of Labor Statistics.

⁷ Bureau of Labor Statistics.

B. Washington State Demand

“Although all careers require a foundation of mathematical knowledge, some are mathematics intensive. More students must pursue an educational path that will prepare them for lifelong work as mathematicians, statisticians, engineers, and scientists.” National Council of Teachers of Mathematics

Washington State mirrors national demand for STEM degrees and Mathematics education. Demand in occupations requiring a STEM degree is grossly unmet in the state. This has resulted in employers recruiting external talent in large numbers and requesting legislative approval to continue this practice. Thus, it is a strategic imperative for the state to focus on STEM education now because many of Washington’s key economic sectors require a STEM educated workforce.

Also, according to the 2010 LMEA report for the state, jobs requiring a bachelor’s degree or higher levels are projected to increase by 2018 at a faster rate than all other jobs. During the same period, there is projected decline in jobs requiring AA degrees.⁸ Occupations in the table below were extracted from a list of the “50 fastest growing occupations in the State of Washington.” This information supports growth in mathematics intensive occupations as indicated by the “percent change” column.

| Occupation | Employment | | Percent | Top 50 |
|--|------------|--------|---------|--------|
| | 2008 | 2018 | Change | Rank |
| Biomedical engineers | 420 | 670 | 60% | 1 |
| Network systems and data communications analysts | 11,880 | 16,180 | 36% | 3 |
| Market research analysts | 9,710 | 12,320 | 27% | 14 |
| Computer and information scientists, research | 1,750 | 2,130 | 22% | 21 |
| Computer software engineers, systems software | 18,560 | 22,470 | 21% | 27 |
| Survey researchers | 110 | 140 | 21% | 29 |
| Computer software engineers, applications | 25,000 | 30,240 | 21% | 30 |
| Farm and home management advisors | 630 | 750 | 20% | 31 |
| Computer programmers | 11,500 | 13,730 | 19% | 33 |
| Network and computer systems administrators | 11,930 | 14,140 | 19% | 37 |
| Materials scientists | 190 | 220 | 17% | 41 |
| Mathematicians | 60 | 70 | 16% | 43 |
| Civil engineers | 14,330 | 16,630 | 16% | 45 |
| Physicists | 500 | 580 | 15% | 49 |

Table 2 Fastest Growing Occupations Requiring Mathematics Education

⁸ Greg Morgan, et.al. (2010) Washington State Economic Labor Market and Economic Report. Retrieved April 2011, http://www.workforceexplorer.com/admin/uploadedPublications/10891_2010_Annual_Report, p. 40.

C. *Regional and Community Demand*

The state and region are currently experiencing economic recovery. King and Snohomish Counties have industries that will contribute to the recovery through production and employment. This includes technology, aerospace, engineering and development.

1. **Snohomish County**

The manufacturing sector is Snohomish County's largest, in terms of jobs, and is dominated by the aerospace products and parts manufacturing industry. Manufacturing is highly sensitive to conditions of the global economy. Snohomish County's manufacturing workforce contracted in 2008 and 2009. In 2010, demand for Boeing's commercial products increased. The company has ramped up production schedules and hiring over the past several months. In Snohomish County, manufacturing is responsible for the recovery of many jobs in 2010, and is anticipated to continue to fuel growth throughout 2011. The table below identifies occupations in Snohomish County that project strong growth. Again, these are occupations that require mathematics education.⁹

| Snohomish County | Employment Projections | | | % Change |
|---------------------------|------------------------|-------|--------|----------|
| | 2008 | 2018 | Change | |
| Biomedical Engineers | 30 | 52 | 22 | 73.3 |
| Computer Systems Analysts | 590 | 620 | 30 | 5.1 |
| Accountants and Auditors | 1,838 | 2,059 | 221 | 12 |
| Financial Analysts | 298 | 328 | 30 | 10.1 |

Table 3 Employment Demand Data for Snohomish County

2. **King County**

King County is the largest business center in both the state of Washington and the Pacific Northwest with cutting-edge companies and a reputation for innovation. The county is home to some of the world's most successful businesses including Amazon.com, Boeing Commercial Airplanes, Costco, and Microsoft. King County is a leading global center for several emerging industries, including aerospace, biotechnology, clean technology, information technology, and international trade and logistics. These factors contributed to the County's ability to weather the economic downturn and are moving the County to economic recovery. The need for STEM education and graduates with stem degrees is a clear mandate for King County.

⁹ Anneliese Vance-Sherman, (2011). Snohomish County Labor Area Summary. Retrieved May 2011, http://www.workforceexplorer.com/admin/uploadedPublications/11101_Sno_0311.pdf.

| King County | Employment Projections | | | % Change |
|---|------------------------|--------|--------|----------|
| | 2008 | 2018 | Change | |
| Biomedical Engineers | 332 | 514 | 182 | 54.8 |
| Mathematicians | 18 | 20 | 2 | 11.1 |
| Compensation, Benefits, and Job Analysis Spec | 1,305 | 1,490 | 185 | 14.2 |
| Statisticians | 471 | 524 | 53 | 11.3 |
| Computer Systems Analysts | 10,298 | 11,471 | 1,173 | 11.4 |
| Accountants and Auditors | 13,655 | 15,464 | 1,809 | 13.2 |
| Financial Analysts | 2,021 | 2,343 | 322 | 15.9 |

Table 4 Employment Demand Data for King County¹⁰

IV. Student Demand

UW Bothell has in place an intentional process to develop new degrees. A necessary piece is student input. In gathering information from students to determine if a new degree is a priority we survey students, review enrollment data from regional and national schools and gather information from advisors and recruiters. Surveys are posted on the UW Bothell website to measure interest in potential degrees and to get student feedback. Surveys are open to potential students who visit the site as well as students currently enrolled at UW Bothell. Students are directed to surveys from UW Bothell's *Academics* homepage of the website. The site includes a general interest survey that lists thirteen potential degrees. The survey limits selection to one potential degree and individuals can not repeat the survey. Mathematics has been included in the general survey since fall 2010 and has risen to the top of potential degrees selected by 18% of the respondents as their preferred major.

Surveys for each potential degree are posted to gauge specific interest. The survey specific to Mathematics has (14) questions and was posted February 2011. It has 14 respondents to date and of this number, two-thirds are current UW Bothell students; the others are planning to transfer to UW Bothell. Comments recorded by respondents are:

"I would like to see more opportunities to enroll in math classes for those who have completed calculus 1, 2, & 3." and

"If a BS in Mathematics is not offered at UW Bothell, I plan to transfer after two years to a University offering this degree."

¹⁰ Anneliese Vance-Sherman, (2011). King County Labor Area Summary. Retrieved May 2011, <http://www.workforceexplorer.com/admin/uploadedPublications/>.

Given this strong input from students, UW Bothell will be responding to an identified student demand in delivering the proposed STEM degree in Mathematics.

V. Relationship to HECB Master Plan & State and Regional Needs Assessment

The Higher Education Coordinating Board (HECB) outlines two primary goals in its strategic plan¹¹:

Goal 1: We will create a high-quality higher education system that provides expanded opportunity for more Washingtonians to complete postsecondary degrees, certificates, and apprenticeships.

Goal 2: We will create a higher education system that drives greater economic prosperity, innovation and opportunity.

UW Bothell's charge is to provide educational opportunity and increase access for the region and community. We structure every program with the goal of incorporating flexibility and support for our students who are non-traditional or from underserved populations. The proposed degree program addresses regional demand for STEM degrees by educating graduates who will be prepared to enter high demand and growth fields in the State. It is deliberate in its structure to support transfer students and to encourage enrollment of underrepresented students. It will influence secondary education and pipeline institutions to strengthen and support preparation for the study of STEM curricula.

A. HECB Master Plan Strategies

As noted above, the proposed Mathematics program is designed to realize core objectives in the HECB's Master Plan concerning educational attainment¹²:

1. **Focus on diversity.** UW Bothell strives to bring a significant population of non-traditional students to science and technology fields, including underserved populations and students with disabilities. Included in the seven priorities of the 21st Century Initiative is our commitment to diversity and inclusiveness.

Implementation of the "21st Century Initiative" includes identifying barriers to enrollment and developing

¹¹ Washington State Higher Education Coordinating Board (HECB), 2008 Strategic Master Plan for Higher Education in Washington - Moving the Blue Arrow Pathways to Educational Opportunity. Olympia, 2007, p ii.

¹² HECB, 12.

strategies to surmount barriers.¹³ Enrollment data from Science and Technology's (S & T) existing degree programs underscores commitment to having a student body that represents the society which we serve.

2. Create higher expectations for K-12 students. The proposed Mathematics program incorporates recommendations from the task force reports to include channels of engagement with regional high school faculty and students. This may be realized through math education components of the proposed degree or collaborative curriculum and projects.

B. State and Regional Needs Assessment Report 2006(SRNA)

According to the State and Regional Needs Assessment Report, the state is not producing graduates to meet demand in STEM fields and notes that the number of degrees awarded in math, physical science, health and engineering have declined.¹⁴

1. Fill unmet needs in high-demand fields. The need for graduates in Mathematics is supported by the data in the proposal. Additionally, UW Bothell is located in a region where the impact of STEM related industries have global impact. We are persuaded by regional partners to create programs that will provide industry-ready graduates. The proposed program will foster leadership and innovation in its graduates and produce individuals with problem-solving abilities who are prepared to meet global challenges.

2. Promote student enrollment in health and science fields. Current and potential students have identified Mathematics as an advantageous degree. It complements curriculum in other UW Bothell Programs outside of S & T including CSS, Education, IAS, and Business. It also links to CUSP (lower division) and UW Bothell's academic support centers.

3. Expand research capacity: The SRNA report refers to a declining number of graduates in research while noting a need for higher levels of training. Mathematics is exceptional in providing students with a strong foundation to pursue advanced study in numerous disciplines. This degree will present opportunity for existing faculty are supported in the advancement of research as well. Additionally, UW Bothell is in the process of developing graduate education that is in alignment with undergraduate education. This translates into strong potential for research to feed the development of science and technology initiatives that will contribute to the campus, community and the state.

¹³ UW Bothell, (May 2008), The 21st Century Campus Initiative. Retrieved March 2011, <http://www.uwb.edu/21stcentury/>.

¹⁴ HECB, State and Regional Needs Assessment Report, Olympia, 2006, p. 3-4.

VI. Proposed Curriculum

The proposed curriculum is designed to streamline students both coming into the program (transferring from community college) and moving on beyond the program (Master of Education – M.Ed.). The Mathematics Basic Core Requirement may be completed at local community colleges (i.e., Cascadia, Edmonds, Shoreline, etc.) and Bellevue College as demonstrated for Cascadia Community College on the list below. Additionally, the senior-level mathematics education courses will streamline students into the M.Ed. in Teaching as well as the future mathematics endorsement.

A. *Bachelor of Science in Mathematics*

The proposed **Bachelor of Science in Mathematics** requires completion of 95 credits. It is in alignment with Community College mathematics curriculum to facilitate seamless transfer. The curriculum is also intended to support students wishing to streamline their mathematics degree with the Masters of Education program.

Courses are distributed in four segments: basic core, advanced core, electives, and supporting science:

1. **Mathematics Basic Core Requirement (35 credits)**

| | |
|---|-------------------------|
| B MATH 124, 125, 126 <i>Calculus</i> (15) | (CC MATH 151,152, 153)* |
| STMATH 307 <i>Differential Equations</i> (5) | (CC MATH 238) ** |
| STMATH 308 <i>Matrix Algebra</i> (5) | (CC MATH 208) ** |
| STMATH 324 <i>Multivariable Calculus I</i> (5) | (CC MATH 264) *** |
| STMATH 341 <i>Introduction to Statistical Inference</i> (5) | (CC MATH 235) ** |

*Represents the course equivalencies for Cascadia Community College (CC).

**Represents the course equivalencies for Cascadia Community College (CC) with *Calculus II* pre-requisite.

***Represents the course equivalencies for Cascadia Community College (CC) with *Calculus III* pre-requisite.

2. **Mathematics Advanced Core Requirement (20 credits)**

| |
|---|
| STMATH 300 <i>Foundations of Modern Mathematics</i> (5) |
| STMATH 381 <i>Discrete Mathematical Modeling</i> (5) |
| STMATH 402 <i>Abstract Algebra I</i> (5) |
| STMATH 424 <i>Introduction to Analysis I</i> (5) |

3. **Mathematics Electives (Choose 5 courses - 25 credits)**

| |
|---|
| STMATH 326 <i>Multivariable Calculus II</i> (5) |
| STMATH 390 <i>Probability and Statistics in Engineering and Science</i> (5) |
| STMATH 403 <i>Abstract Algebra II</i> (5) |

STMATH 420 *History of Mathematics* (5)

STMATH 425 *Introduction to Analysis II* (5)

STMATH 444 *Foundations of Geometry* (5)

STMATH 4X1/BEDUC 5X1 *Fostering Algebraic Reasoning* (5)

STMATH 4X2/BEDUC 5X2 *Fostering Geometric Reasoning* (5)

STMATH 4X3/BEDUC 5X3 *Fostering Data, Graphical & Statistical Understanding* (5)

4. Supporting Science Course Requirements (15 credits)

B PHYS 121 *Mechanics* (5); B PHYS 122 *Electromagnetism & Oscillatory Motion* (5)

CSS 161 *Fundamentals of Computing* (5)

The course sequence that supports mathematics education incorporates: STMATH 420, 444, STMATH 4X1/BEDUC 5X1, STMATH 4X2/BEDUC 5X2, and STMATH 4X3/BEDUC 5X3.

B. Description of Courses

Much of the curriculum listed above is already being offered to support the S&T Electrical Engineering major. The entire core curriculum is currently offered every year. Most of the newly proposed required and elective courses are accepted and well-defined sub-areas of mathematics so we will not describe them in detail. It is expected that electives will evolve with experience and curricular growth. The general guideline will be that electives require Calculus II as a prerequisite.

Additionally, the proposed course numbering reflects mathematics offerings at UW Seattle and course descriptions are in the UW General Catalog. Three courses, however, do not fall in this category:

- STMATH 4X1/BEDUC 5X1 *Fostering Algebraic Reasoning* (5)
- STMATH 4X2/BEDUC 5X2 *Fostering Geometric Reasoning* (5)
- STMATH 4X3/BEDUC 5X3 *Fostering Data, Graphical & Statistical Understanding* (5)

These courses are being developed and offered in collaboration with UW Bothell Education. The courses are designed to combine mathematics content and pedagogy that will directly apply to the student's future secondary mathematics classroom.

C. Resources

While there are many new courses proposed for this degree, many are electives and can be run on a rotating basis. We have several mathematics faculty in S&T who can provide support for the development and teaching of these courses: Peter Littig, Linda Simonsen, Andrew Abian, Eric Salathe, Roberto Altschul, and Kim Gunnerson. It is predicted that future hires will be needed as this program matures.