

# Appendices



## **A&SPIRE YEAR TWO (2015-2016)**

### **APPENDIX IV**

#### **Science Research Fellows (SRF) Proposal**

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**Objective:** In response to the College of Arts & Sciences strategic plan, Theme 4, Act of Determination 5 “Benchmarks and Practices for Enrollment Management in the Health Sciences,” we aim to create a new interdisciplinary major called the Science Research Fellows (SRF). Students selecting this major will earn a Bachelor of Science degree from the College of Arts & Sciences. This major will attract high-achieving students interested in scientific research in the areas of biology, chemistry, biochemistry, psychology, neuroscience, environmental science, anthropology, geology and physics.

The SRF aims to develop a research-rich curriculum that prepares students in multiple aspects of scientific inquiry and place them in research labs by the fall of their sophomore year, where

the student will continue to conduct research until they finish their degree. The creation of this program will help Baylor “educate greater numbers of the world’s most academically talented students” as *Pro Futuris* planned and *A&Spire* reaffirms. Although SRF will be a small program of approximately 10 students accepted yearly, it will be highly effective in providing research opportunities for the students and personnel for faculty mentors. This will potentially increase their number of publications and grant funding. The program also provides faculty the opportunity to mentor exceptional undergraduate students while at the same time giving the student a closer mentor relationship.

Other universities have programs in place that prepare students for the rigors of research. The University of Texas in Austin has the Freshman Research Initiative, while University of Arizona has the Undergraduate Biology Research Program. Both of these prepare the student during their freshmen year to do research but do not require them to join a research lab. The Biology Department at the University of Utah offers a Bioscience Two-year Training Program geared toward students interested in biomedical science, biochemistry, cell and molecular biology, genetics, physiology, morphology, and ecology. Indiana University at Bloomington has the Science, Technology, and Research Scholars (STARS) that prepares selected students during their freshman year and guides the student until they graduate. They also offer the Integrated Freshman Learning Experience (IFLE), a two-phase program that includes summer research in a lab of their choice as well as coursework during their freshman year that covers techniques, research literature, and group experiments. The SRF program resembles the STARS program in that students would be guided and mentored through their entire undergraduate career.

### **Admission to the Program**

We anticipate that admission to the program will be highly competitive and will attract high achieving students that come to Invitation to Excellence (I2E) and Baylor-to-Baylor (B2B) programs. Students with an SAT scores of 1400 or above (critical reading and math) and/or ACT of 32 or above will be eligible to apply.

Students will be able to apply to the Science Research Fellows once they have committed to Baylor University by:

- 1) Submitting an application online.
- 2) Writing a 500-word essay on why the Science Research Fellows program is a good fit for them.
- 3) Provide two letters of recommendation from high school teachers (at least one from a science teacher) to be sent to the Science Research Fellows Program Director.

To ensure the quality of the program and guarantee students are placed in a research group, only a small group of approximately 10 students will be selected each year. Students accepted into the SRF major can also be part of the Honors Program if they decide they want this option. Cases may be considered for admission on an individual basis after the end of their first semester.

### **Maintaining Science Research Fellow (SRF) Status**

To maintain the quality of the program, Science Research Fellows will be required to demonstrate satisfactory progress in order to maintain their SRF status. The SRF director will closely monitor the student's course selections and their progress in class and research to ensure any problems that arise are addressed in a timely manner. In addition, students' progress will be evaluated every year by the SRF Committee.

Satisfactory progress is defined as maintaining an overall 3.5 GPA, performing satisfactorily in their research (as evaluated by the lab PI) comporting themselves with the utmost honesty and integrity, and earning grades of B or better in every science courses each semester. Students who fall below the 3.5 GPA minimum will be given one semester to raise their GPA to 3.5. If the student fails to meet the minimum GPA a second semester, s/he will be dismissed from the program.

### **Course Requirements for the SRF Major**

To graduate with a B.S. in Science Research Fellows, students admitted to this interdisciplinary program must complete:

- REL 1310 and REL 1350
- Two semesters of Chapel
- PSC 2302
- ENG 3300
- Complete 21 hours of upper division science courses with prefixes BIO, CHE, PHY, PSY, NSC, ENV, ANT, and GEO.
- Complete a minimum of 16 hours of SRF credits including SRF 1306, 1307, 4102, and 4103.
- Completion of 124 hours including 36 hours of 3000/4000 level credits

The requirement for advanced credit, residence, chapel, and maximum credits are the same as for Bachelors of Science. Most of the coursework is already in place but the creation of five courses will be necessary.

The proposed courses are:

**SRF 1306/1307: Scientific Process and Research Techniques**

SRF 1306 and SRF 1307 will be a preparatory course for Science Research Fellows who will enter into research laboratories the fall of their sophomore year. The course will be a lecture to be team-taught by professors or lecturers in the departments of Biology, Chemistry and Biochemistry, Environmental Science, Geology, Physics and Psychology and Neuroscience. Each discipline will cover the main research techniques used in their fields. Based on feedback we have received, the class could also extend to include technical writing, scientific literature, and clinical research methods including basic methods in epidemiology and public health. These courses will count as part of the workload for the teachers of record.

Fellows will be challenged to utilize the scientific process in the classroom as they engage in case studies and gain knowledge and understanding on the different techniques used in chemistry, biology, psychology/neuroscience, and environmental science.

Listed in the appendices are examples of outlines and syllabi for these courses. These examples are somewhat restricted to the developers' areas of research but actual course content may be expanded to other departments depending on the interest of the students and faculty mentors.

**SRF 3V90 Intermediate Research and SRF 4V90 Advanced Research**

Both courses will allow the student to earn advanced credit for performing research. Offering credit for the research will ensure the student spends the needed amount of time in lab and is recognized for his/her work. These two classes can be cross-listed with the research courses offered by the partner science departments. The courses can be taken during the summer if necessary.

At the discretion of the director, SRF students could receive credit for these courses for a research internship during the summer that is not in one of the partner science departments at Baylor. These internships can include, but are not limited to, Baylor Scott & White Research, Baylor College of Medicine, Centers for Disease Control (CDC), and Public Health Services.

**SRF 4101 Senior Research Seminar I and SRF 4102 Senior Research Seminar II**

These courses will be taken by students during their last year at Baylor. In SRF 4101 the student will complete the lab work and data analysis in preparation for presentation and possible

publication. It will be the responsibility of the principal investigator under which the student conducted his/her research to guide this process and ensure the results are accurately interpreted and presented. In SRF 4102 the student will present his/her research in a formal oral presentation to faculty and SRF peers. They are also expected to present their research in a poster session during URSA Scholars week. When funding for the program is available, students will present their findings at the National Conference of Undergraduate Research (NCUR). The grade will be decided by the faculty member and the SRF director.

### **Resources Needed for the SRF Major**

**Science Research Fellows Director:** The director of the Science Research Fellows will be a member of the faculty appointed by the Dean of the College of Arts & Sciences and will receive a one course reduction per semester plus 10 percent compensation during the summer for their service.

The director will oversee all aspects of the program and will be responsible for:

- 1) Recruiting faculty as potential partners for the program.
- 2) Managing the application process and being the point of contact with potential students.
- 3) Monitoring the student's academic progress as well as research progress.
- 4) Serving as academic advisor to the students.
- 5) Staying in close contact with the science faculty and staying informed of any potential opportunities available in the research labs that could be filled by Science Fellows.
- 6) Keeping the SRF Committee informed of the students' progress.
- 7) Collecting assessment and evaluation data from students and faculty, including data on publications and post-graduation activities of the students that directly relate to their SRF experience.

### **Science Research Fellows Committee**

The Science Research Fellows Committee will be formed by the director, along with STEM professors and lecturers representing departments hosting SRF students in their labs. The committee will take part in the selection process, help design the course curricula, and make recommendations about the direction and management of the SRF program. In addition, committee members will be asked to sit in some (but not all) of the research project presentations.

## **Academic Advisement Committee**

Each Science Research Fellow will have a committee to assist and guide the student in a curriculum that has sufficient rigor and reasonable breadth. The committee will include the student's mentor and one faculty from a department outside the sciences.

## **Conclusion**

The Science Research Fellows Program will undoubtedly help attract a greater number of high-ability students to Baylor University. This distinctive program will provide the opportunity to study and collaborate with faculty mentors and produce research and creative work at the highest quality levels. Engaging in research with faculty in all phases of the discovery process will enhance the connections between teaching and scholarship for the students. According to the Council on Undergraduate Research (CUR), students who have had a good undergraduate research experience are more likely to apply to graduate programs. We predict that these students will also be highly successful in their application to health related professional schools, including medical school.

This program is in concert with the tenets put forth by the university's strategic plan, *Pro Futuris*, and the College of Arts & Sciences strategic plan, *A&Spire*. The Science Research Fellows Program will recruit and retain high-ability students and will train them in excellence in research, scholarship, and service. The program will serve to strengthen Baylor's role as a research university and will increase Baylor's visibility as a premier institution for students interested in research and professional careers.

## **Appendices**

- SRF 1306 Research Techniques I
- SRF 1307 Research Techniques II
- SRF 3V90 Intermediate Research
  - SRF 4V90 Advanced Research
- SRF 4101 Senior Research Seminar I
- SRF 4102 Senior Research Seminar II

## SRF 1306 Research Techniques I

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This course aims to familiarize the student with the scientific process and common techniques and instrumentation used in biology, neuroscience and psychology research labs. Scientific literacy, data analysis and interpretation, and the breadth of scientific exploration are stressed.

### **Books:**

No formal laboratory manual or textbook is required; however, throughout the semester, students will be required to read current and/or seminal research journal articles and laboratory protocols either as preparation for an upcoming lecture or as an extension of themes presented in lab demonstrations.

### **Biology Section (7-8 weeks)**

1. Introduction to the Scientific Process
  - a. Hypothesis Development
  - b. Types of Research
2. Field Biology and Observational Studies
  - a. Study Design, Interpretation and Communication
  - b. Systems Homeostasis Research-Examples and Introduction to Research at Baylor
    - i. Aquatic Systems
    - ii. Microbial Ecology
  - c. Speciation/Population Genetics
3. Studies of Physiology
  - a. Plant Physiology
  - b. Mammalian Physiology
4. Studies of Cellular Biology
  - a. Microscopy
  - b. Genetic Engineering
  - c. Cell signaling

### **Neuroscience/Psychology Section (7-8 weeks)**

1. Methods in Research Psychology
2. Epidemiology and Neuroscience
3. Quantitative Analysis of Psychology and Neuroscience Studies
4. Memory and Cognition
5. Psychological Disorders
6. Intervention Research

## 7. Social Psychology

### Grading:

**Pre-class Written Assignments:** Reading prior to attending class will be necessary for understanding classroom discussion. Homework related to the designated readings will be assigned

**Participation:** SRF 1306 instruction relies on active learning techniques; therefore, one cannot complete the course requirements without being present and actively engaged in discussion.

**In-Class Quizzes:** Short quizzes over the material will be conducted over the course of the semester. The quizzes will assess learning about the reading assignments and the topics explored during discussion.

**Final Written Project and Oral Presentation:** Each student is to do a short presentation (15-20 minutes) concerning a report generated about research in one of the areas studied during the course and designated by the instructor. This presentation will be worth 100 points and student will be evaluated on the quality of the presentation and paper.

Written Assignments	100 points
Participation	100 points
Quizzes	200 points
<u>Final Project</u>	<u>100 points</u>
Total	500 points

Total Points	% Grade	Letter Grade
500 - 450 points	100 – 90%	A
449 - 400 points	89– 80%	B (88 and 89% B+ / 80 and 81% B-)
399 - 350 points	79 – 70%	C (78 and 79% C+/ 70 and 71% C- )
349 - 298 points	69 – 60%	D
299 or less	59% and less	F



## SRF 1307 Research Techniques II

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This course aims to familiarize the student with the most common techniques and instrumentation used in chemistry and biochemistry research labs. The second half of the course is used to introduce the student to toxicology as a way to show how all the science disciplines (biology, chemistry, biochemistry and environmental health) come together.

Books:

1) Rouessac, F. and Rouessac, A., **Chemical Analysis: Modern Instrumentation Methods and Techniques**, New York, Wiley and Sons LTD., 2nd Edition, 2007. ISBN-13: 978-0470859032

2) Klassen, C.D., Watkins, J.B., **Cassarett & Doull's Essentials of Toxicology**, New York, McGraw Hill, 2nd Edition, 2010. ISBN-13: 978-0071622400

### **Chemistry Section (7-8 weeks)**

1. Introduction to Chemical Research Literature – how to find and read an article.
2. Compound Isolation and Purification
  - a. Extraction and Washing
  - b. Color Tests and Thin Layer Chromatography (TLC)
  - c. Purification by Distillation
  - d. Purification by Recrystallization
  - e. Purification by Flash Chromatography
3. Instrumentation
  - a. Gas Chromatography
  - b. LC and HPLC
  - c. UV-Vis Spectroscopy
  - d. IR Spectroscopy
  - e. Electrophoresis
  - f. Mass Spectrometry (MS)
  - g. Tandem Techniques (GC-MS, HPLC-MS, etc.)
  - h. Protein Assays
  - i. Nuclear Magnetic Resonance ( $^1\text{H-NMR}$  and  $^{13}\text{C-NMR}$ )
4. Quality Control

### **Toxicology Section (5-6 weeks)**

1. Principles of Toxicology
2. Pharmacokinetics and metabolism
3. Chemical Carcinogenesis

4. Genetic and Developmental Toxicology
5. Organ Toxicity
6. Environmental toxicology
7. Forensic Toxicology

**Grading:**

**Partial Exams:** There will be 3 partial exams during the semester. Each exam will be worth 10 points.

**Final Exam:** The final exam will be comprehensive covering all topics covered during the semester and any other material that was assigned. The final exam will be 150 points.

**Presentation:** Each student is to do a short presentation (15-20 minutes) on a research article in one of the areas studied during the course and designated by the instructor. This presentation will be worth 50 points and student will be evaluated on the quality of the presentation.

Partial Exams	300 points
Final Exam	150 points
<u>Presentation</u>	<u>50 points</u>
Total	500 points

Total Points	% Grade	Letter Grade
500 - 450 points	100 – 90%	A
449 - 400 points	89– 80%	B (88 and 89% B+ / 80 and 81% B-)
399 - 350 points	79 – 70%	C (78 and 79% C+ / 70 and 71% C- )
349 - 298 points	69 – 60%	D
299 or less	59% and less	F

### **SRF 3V90 Research Problems**

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A research project conducted during the sophomore year under the supervision of a Baylor faculty member. A minimum of three clock hours of work per week in the laboratory will be required for each semester hour of credit. This course may be repeated once if research continues.

Before a grade is assigned the student is required to write a summary of what s/he did in lab during the semester and submit it to the SRF Director for approval. The grade will be decided by the faculty member and the SRF director.

### **SRF 4V90 Senior Research Problems**

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A research project conducted during junior or senior year under the supervision of a Baylor faculty member. A minimum of three clock hours of work per week in the laboratory will be required for each semester hour of credit. This course may be repeated once if research continues.

Before a grade is assigned the student is required to write a summary of what s/he did in lab during the semester and submit it to the SRF director for approval. The grade will be decided by the faculty member and the SRF director.

### **SRF 4101 Senior Research Seminar I**

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These courses (SRF 4101 and 4102) will be taken by the student during their last year at Baylor. In SRF 4101 the student will complete the lab work and data analysis in preparation for presentation and possible publication. It will be the responsibility of the principal investigator under which the student conducted his/her research to guide this process and ensure the results are accurately interpreted and presented.

### **SRF 4102 Senior Research Seminar II**

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In SRF 4102 the student will present his/her research in a formal oral presentation to faculty and SRF peers. They are also expected to present their research in a poster session during URSA Scholars week. When funding for the program is available, students will present their findings at the National Conference of Undergraduate Research (NCUR). The grade will be decided by the faculty member and the SRF director.