



Training, Research and Education in Engineering for Cultural Heritage Diagnostics

# IGERT Handbook

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IGERT  
(Integrative Graduate Education and Research Training)  
TRAINING, RESEARCH AND EDUCATION IN ENGINEERING FOR  
CULTURAL HERITAGE DIAGNOSTICS (TEECH)

Student & Faculty Handbook

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## 1. Program Overview

Diagnostic engineering for cultural heritage is a new field that has emerged from forensic engineering – the application of engineering sciences to the investigation of failures, failure mechanism or other performance problems. We are to create a novel research and education program for graduate students from structural engineering, computer science, electrical engineering, anthropology, art history and material science, focused on the development of diagnostics methodologies and analytical models and tools for us in the conservation of art, historic structures and archaeological artifacts.

## 2. Vision and Goals

Students are to develop methodologies and techniques for the creation of ‘digital clinical charts’ that capture a baseline understanding of an artifact’s health, then monitor that health over time, as a prelude to making decisions about restoration, repair and other solutions for safeguarding the cultural asset. More specifically, students are to develop new integrative ‘health monitoring’ methodologies drawing from multi-spectral imaging, non-invasive materials characterization, diagnostic and predictive modeling, simulation, data synthesis and visual analytics, culminating in integrative diagnostics and prognostics techniques.

The program is to train students in, and contribute to, the use and development of cyberinfrastructure and engineering applications that are critical to the long-term monitoring and predictive health of cultural artifacts.

## 3. Fellows and Associates

Students receiving stipends from the IGERT project are considered IGERT Fellows. Students who do not receive NSF IGERT stipends but have submitted an IGERT essay and are participating in IGERT classes and activities including IGERT surveys and other trainee reporting requirements are considered IGERT associates. IGERT courses and events are open to all interested UCSD graduate students. All are welcome to participate in the program and attend IGERT courses and events regardless of funding source or status as an IGERT participant.

### 3.1 Funding - IGERT Funding

IGERT fellows are paid the NSF required stipend rate of \$30,000 per year. The typical IGERT award is for 1 or 2 years. In addition, NSF provides up to \$10,500 for costs of education (tuition and fees). Additional fees are to be paid by ????. The NSF IGERT program discourages supporting students in fractions of a year so awards will run for full year increments. Students are not allowed under NSF rules to hold other fellowships, RA-ships or TA-ships while supported by IGERT.

### 3.2 Funding - Diversity Awards

Ten UCSD Diversity Fellowships will be provided over the program period, further increasing minority

participation. In addition, ten UCSD Chancellor's Interdisciplinary Collaboratories Fellowships will be available during the first year with a possibility for renewal. These fellowships are designed to stimulate transdisciplinary collaborations between faculty and students from different departments across campus, and will provide a unique translational component and broad impact of IGERT-TEECH.

### **3.3 Funding – Out-year and Levels of Support**

It is the responsibility of the IGERT trainee and his/her mentors to identify funding for the trainee when not supported by IGERT. It should be noted that stipends for other forms of funding are typically below the IGERT stipend rate, so the trainee should plan accordingly. Trainees are advised to consult early with the graduate program director in their academic department to discuss departmental sources of support and other funding opportunities.

## **4. Student Responsibilities**

Regardless of funding once a student is named an IGERT participant that student assumes specific responsibilities during their tenure as a graduate student at UCSD.

### **4.1 Biographical Statements/Website**

Each participating student should submit a biographical statement and photo for the IGERT TEECH website. For format please see examples: ...

Past experience shows that these bios are useful for potential employers, journalists and potential collaborators, and fellow students in addition to potential donors. Your bios and photographs will also be used (with your edits and permission) on the IGERT.org web site that advertizes our IGERT project and links our project with other IGERTs around the country and the development office for fund raising purposes. You can also post videos or other information on your page for the IGERT.org site.

### **4.2 Diversity outreach**

NSF and the University of California have a strong interest in expanding the reach of the Interdisciplinary Program and other academic programs to a wide group of students underserved by the university. These include students from minority backgrounds, students with disabilities and economically disadvantaged students. We would like you to participate in outreach activities to traditionally underrepresented students through participation in presentations to undergraduates at schools with large diverse populations, hosting or mentoring students in undergraduate summer research programs for diversity undergraduate students (such as U.C. STARS), or mentorship programs (e.g., MSPHD). Some events to consider:

1. SACNAS (Society for Advancing Chicanos/Hispanics & Native Americans in Science) annual conference
2. California Forum for Diversity in Graduate Education
3. Local minority serving institutions such as California State university ( Los Angeles, San Diego Fullerton and San Marcos) and local community colleges
4. Diversity events at professional conferences (e.g. )

Although IGERT specifically prohibits use of funds for conference attendance, NSF has approved limited funds for specific diversity outreach activities.

### 4.3 Donor Outreach

Students who receive support from donors may be asked to meet with donors and potential donors and development office staff to discuss your research and your experiences in the program. Experience with donor-based fund-raising is an important skill and we encourage students to participate.

## 5. Program Requirements

Each student in the IGERT program has a “primary department” at UCSD, where the student is pursuing a Ph.D. degree. The IGERT program creates a layer of structure on top of the requirements of the primary department. Thus, the student must complete the IGERT requirements in addition to all of the requirements of his/her primary department (some may overlap).

The objectives of the IGERT program can be summarized in one statement: The students should develop significant interdisciplinary expertise in the program’s thematic areas, and their dissertations should contribute to the literature in this regard. The requirements of the program can be divided into four main categories: (1) mentorship, (2) course work, (3) field experience and (4) group research. The remainder of this section gives details on these requirements, followed by a description of related activities and opportunities for internships and grants through the program.

### 5.1 Doctoral mentorship

Student mentorship will draw inspiration from the many participating disciplines to create a fresh and transformative new approach:

1. **all students will have three faculty advisors** – one from the student’s core domain and the others from two of three other thrust areas (Engineering/Arts/Education/Anthropology);
2. we will create a **mentor orientation/workshop**, to continuously develop, revise and disseminate best-practice approaches within our team;
- a. 3) each student will also be assigned an **international expedition liaison**, local to the Florence or Jordan field sites, to enhance the value of the international research and education experience;

3. incoming PhD students will be paired with senior PhD students, providing one-to-one mentorship in respect to daily student life.
4. we will establish a monthly **Presentations and Journal Club** to further ensure the cohesiveness of the program and collaborations among students and sharpen presentation skills and build cohesiveness;
5. a **targeted workshop** will be created to allow students to develop skills needed to get ideas across accurately and persuasively in a variety of contexts; and
6. we will create an **annual retreat** to strengthen team synergy and lay the foundation for a book about cultural heritage diagnostics that will be developed by the entire team.

Co-PIs Wienhausen (Associate Dean for Education, BioSci), Baxter (Director for Education, SDSC) and Van Den Einde (Assistant Director, NEESit) in close collaboration with PI Kuester, will lead the mentorship and curriculum task force for this program. PIs Kuester, Levy and Seracini are currently mentoring graduate students from Computer Science, Structural Engineering, Archaeology and Art History. PI Kuester has served as research advisor and mentor to over 100 students, including many programs to encourage students from disadvantaged backgrounds to pursue graduate degrees (McNair Fellowship Program, and the California Alliance for Minority Participation in Science, Engineering and Mathematics). Co-PI Levy has trained over 500 UC San Diego students on field archaeological expeditions, many of whom have gone on to M.A. and Ph.D. programs.

Students are encouraged to choose a primary thesis advisor by the end of their first year of IGERT funding. Switching advisors after the first year is possible and typically requires agreement of the new thesis advisor and commitment of funding to the student. Students are encouraged to establish relationships with prospective thesis advisors and secondary thesis advisors by taking the courses offered by the faculty members of interest, working in a professor's research group on a project, and by meeting directly with the faculty members. IGERT funding can help cement an advisee/advisor relationship by defraying costs normally borne by the advisor for student support. Hence, it is useful to negotiate with potential advisors at the start of one's IGERT funding rather than at its conclusion.

Although there are variations across departments, students are encouraged to begin research early in their academic careers, with the goal of developing a thesis proposal and advancing to candidacy (completing the C.Phil. examination) by the end of the third year in a Ph.D. program. The optimal timing of a student's entrance into the IGERT program depends on the course requirements of the student's primary department and thus may vary across departments.

A faculty member who serves as a student's main thesis advisor or secondary advisor should: (a) allow the student to take the required IGERT Program courses, (b) annually provide a short summary of the student's academic progress to the IGERT Program office, and (c) serve as a member of the IGERT Program Steering Committee or subcommittee (typically a one year commitment) at some point during the student's tenure as a UCSD graduate student. Advisors are also encouraged to participate in offering courses that enhance the IGERT Program's curriculum.

## 1. Coursework

The IGERT Program has the following core course requirements which all students in the program must complete:

- Diagnostic imaging (Kuester)
- Seminar (Levy)
- Any other courses

### SE 207: Forensic Engineering

This course will be applications/problem based and provide an introduction to forensic engineering techniques with focus on imaging diagnostics. A broad range of imaging techniques will be studied for the multi-dimensional analysis of engineered artifacts with the aim, to detect conditions that may lead to undesirable performance characteristics or failure, identify the onset of failure, failure progression and failure mechanisms overall. Techniques that will be studied and in many cases applied to the analysis of engineered artifacts, include:

- Giga-pixel photography
- Photogrammetry
- Structured light based imaging
- Light detection and ranging (LIDAR)
- Infrared imaging (IR)
- Ultraviolet imaging (UV)
- Thermal imaging
- X-ray imaging (radiography / tomography)
- Neutron activation imaging
- Terahertz Imaging

The requirements for taking the course include active participation in class discussions, study and synthesis of research publications, hands-on problem solving leveraging integrative diagnostics techniques, drawing from data acquisition (imaging), modeling, analysis and visualization.

Students are welcome and encouraged to take additional interdisciplinary courses as their schedules allow. Below are descriptions of additional courses developed or planned in conjunction with the IGERT program; these are electives and not required.

**ANTH 258. Analytical Methods in Archaeology (4)** Specialized scientific techniques are increasingly important to archaeology. This seminar examines chronometric date techniques, site-formation processes, and geoarchaeology and pedology, chemical analyses of soils, zooarchaeology, palaeoethnobotany, and how land-use strategies can be inferred from archaeological remains. [Formerly known as ANGR 258.] **Prerequisite:** graduate standing. For students whose research intersects with archaeology, this course is strongly recommended.

**NAR 111 Foundations of Archaeology:** theories and methods used for investigating human and social evolution.

**NAR 190 Middle East Archaeological Field School (Jordan):** introduction to research project design, data collection techniques, excavation methods, with post-excavation lab work, study trips, and a field journal.

## 2. Field Experience

During the initial program period, students will participate in multi-month excursions to two international field sites after first applying and sharpening their skill set in conjunction with payload projects. While the lion's share of the activities will be carried out at the University of California, San Diego, this program will provide graduate students with extensive hands-on experience and training at *international* locations in Italy and the Middle East. Two international field projects will be integrated with this program, one in Florence, Italy (arts/architecture/structural engineering) and the other in Jordan (archaeology), providing hands-on fieldwork and interaction with local student teams working at those sites.

In both Florence and Jordan, the students will do hands-on fieldwork and interact with local teams of graduate students involved in analyzing historic artifacts. An important focus of these field experiences will be the deployment of field cyberinfrastructure (CI); in our experience, it is important when doing field studies to impose metadata and data protocols from the very outset when primary data is first being collected in the field. Students will be trained on field CI to support a variety of different types of data, from field notes (text), to photographs, videos, maps, 3D scans, and remote sensing data.

### 5.4 Group Research

The IGERT Program requires that the students engage in some group research. This is defined broadly to include instances in which a given student obtains significant feedback from another student from a different field (preferably in the first student's secondary field), and the output of this interaction is evident in the student's dissertation as contributing to the interdisciplinary component.

Another example of group research is when two or more students in the IGERT Program work together on a project, leading to an interdisciplinary position paper or publishable technical paper. The projects may be presented at an IGERT symposium, posted on the IGERT website, and ideally submitted for publication.

Group research projects may also develop from courses.

### 5.5 Related Activities and Support

#### 5.4.1 Mini-grants

The Mini-grant program provides funds to support any aspect of a student's individual research program



or a group project, including materials and supplies for research, travel, publication charges, and costs for field assistance. These funds cannot be used for conference travel or participation. Grants can be up to \$10,000. Funds are available through a competitive granting process using short NSF-style proposals that are reviewed and granted by the IGERT Program Executive Committee.

The IGERT Program Executive Committee may ask for clarification, revisions or re-submission of Mini-grant proposals. Students are not guaranteed grant support, but the executive committee aims to provide at least modest support to every deserving student. Furthermore, normally a student would obtain no more than one mini-grant during his/her time in the program. Proposals are accepted and reviewed three times each year, coinciding with the academic year quarters (Fall, Winter, Spring). The deadline for mini-grant applications is the last day of classes in each quarter, as designated in the UCSD academic calendar. Instructions for preparing and submitting Mini-grant proposals are given in Appendix B.

### **5.4.2 Internships**

All IGERT students will be required to participate in an internship and mentoring program for career development. We will leverage existing internship programs at UC San Diego, including the Jacobs School of Engineering's Team Internship Program, which enhances students' education through real-world team engineering experiences at sponsoring institutions. Students will also fulfill this requirement with internships in museums, corporate or government-related cultural institutions in San Diego or abroad.

### **5.4.3 Reporting**

Students in the IGERT Program are required to complete the annual IGERT Survey, which is normally due in April of each year or when requested by NSF. Please submit via email to [xmwang@ucsd.edu](mailto:xmwang@ucsd.edu) a single .doc file addressing each of the following categories (use each as a subheading) for the annual report to NSF.

- a. Publications -list full citation (include all authors)
  - b. Book Chapters
  - c. Conference Publications (Name of the conference and dates, title of publication or poster)
  - d. Conference Presentations (Name of the conference, date of presentation, title of presentation)
  - e. Outreach (includes Op-Eds, TV, Radio, Newspaper) & public (or school) presentations. Include title of presentation or article, media, and date of activity.
  - f. Research and/or Educational achievement or finding and why it is important.
- a. IGERT Highlights w/photos – to address an NSF Strategic Goal as described below.
  - a. Discovery: Foster research that will advance the frontiers of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the Nation as a global leader in fundamental transformational science and engineering.
  - b. Learning: Cultivate a world-class, broadly inclusive science and engineering workforce and expand the scientific literacy of all citizens.
  - c. Research Infrastructure: Build the Nation's research capability through critical investments in advanced instrumentation, facilities, cyber infrastructure, and experimental tools.
  - d. Highlights may be up to 6,000 characters to describe the achievement, with photos, and another 6,000 characters to discuss how this would address the NSF goal.

Sample highlights can be found at:

<http://www.igert.org/highlights/111>  
<http://www.igert.org/highlights/112>

Students are also required to submit information online. IGERT will provide each student with a username and password at the appropriate time.

#### **5.4.4 Evaluation**

Evaluation is a key element to insure that the IGERT-Program trainees are progressing well in both their departmental Ph.D. programs and the IGERT Program. Evaluation is performed mainly through each student's Trainee T Competency and Outcome Journal. Working with project evaluators, all IGERT affiliated students are required to complete the T Competency exercise upon program entry and maintain an outcome journal. These instruments are used to help students with goal setting and to evaluate progress over time.

#### **5.4.5 Annual (Re-)Orientation Meeting**

The (re-)orientation meeting is a time to reflect on program progress. The meeting is held in when? The agenda includes formal evaluation exercises and group discussion on changes to the program and issues that need to be addressed by the Executive Committee. Participation is required.

## **6. IGERT Committees**

### **6.1 Executive Committee**

PI and Co-PIs on the IGERT grant serve as the executive committee. The committee makes any time sensitive decisions required for the program's successful implementation insuring that those decisions reflect the program's visions and goals. Committee members may make decisions via teleconference or email when meetings are impossible.

Members:

Falko Kuester, PI  
Tom Levy, Co-PI  
Maurizio Seracini, Co-PI

### **6.2 Faculty Steering Committee (???)**

Membership consists of those faculty and researchers who are truly engaged in the project and it's vision. A commitment to serve on the committee is a minimum of one year. Members serve on the IGERT Steering Committee and attend all Steering Committee meetings.

Meeting schedule:

Current members in addition to the Executive Committee include:

### 6.3 Student Steering Committee???

The student steering committee is a student-organized group from the previous and current IGERT. The committee members insure that students are meeting their commitment to lead and coordinate the IGERT forum, help draft and update this handbook, and serve with faculty on subcommittees. Two student members are selected to serve on the IGERT Steering Committee sharing reports from those meetings with other students, help organize open house activities and host PhD candidates, voice concerns to the Faculty Executive Committee.

## **7. Participants**

Name and Title	Affiliation	Expertise	Role in Project
<b>Falko Kuester</b> Associate Professor	UCSD Calit2, CISA3	Visual Analytics (VA) Cyberinfrastructure	Project PI <b>VA-Leader</b>
<b>Maurizio Seracini</b> Adjunct Professor	UCSD Calit2, CISA3	Integrative Imaging Diagnostics (IID)	Project Co-PI <b>IID-Leader</b>
<b>Thomas Levy</b> Professor	UCSD Calit2, CISA3	Cyber Culture (CLT)	Project Co-PI <b>CLT-Leader</b>
<b>Chaitan Baru</b> Distinguished Scientist	UCSD SDSC	Data Intensive Computing (DIC)	Senior Personnel <b>DIC-Leader</b>
<b>Diane Baxter</b> Education Director	UCSD SDSC	Education (EDU)	Senior Personnel <b>Outreach</b>
<b>Geoff Braswell</b> Associate Professor	UCSD ANT	Archaeometry	Senior Personnel
<b>Jack Greenstein</b> Associate Professor	UCSD VIS	Art History	Senior Personnel
<b>Tara Hutchinson</b> Associate Professor	UCSD SE	Structural Analysis (SA)	Senior Personnel <b>SA-Lead</b>
<b>Michael Kalichman</b> Professor	UCSD SOM	Research Ethics	Senior Personnel
<b>Francesco Lanza di Scalea</b> Professor	UCSD SE	Non-Destructive Evaluation (NDE)	Senior Personnel
<b>Joseph Pasquale</b> Professor	UCSD CSE	Global Seminars on Math Beauty of Rome	Senior Personnel
<b>Brian Schottlaender</b> University Librarian	UCSD University Librarian	Library Science Digital Repositories	Senior Personnel
<b>Michael Todd</b> Associate Professor	UCSD SE, EI	Non-Destructive Evaluation (NDE)	Senior Personnel <b>NDE-Lead</b>
<b>Gabriele Wienhausen</b> Assoc. Dean for Education	UCSD BioSci	Education (EDU)	Senior Personnel <b>Education Leader</b>
<b>Lelli Van Den Einde</b> Lecturer	UCSD NEES, SE	Cyberinfrastructure & Education	Senior Personnel
<b>Yigal Erel</b> Professor	Hebrew University of Jerusalem, Israel	Geochemistry and Environmental Eng.	International Collaborator
<b>Uzy Smilansky</b> Professor	Weizmann Institute of Science, Israel	Computerized Archaeology	International Collaborator
<b>Paolo Spinelli</b> Professor	University of Florence, Italy	Structural Engineering	International Collaborator
<b>Maurizio De Vita</b> Professor	University of Florence, Italy	Historic Architecture	International Collaborator

ANT: Department of Anthropology (<http://www.anthro.ucsd.edu>)

BioSci: Biological Sciences (<http://biology.ucsd.edu>)

CSE: Department of Computer Science and Engineering (<http://www-cse.ucsd.edu>)

SE: Department of Structural Engineering (<http://structures.ucsd.edu>)

VIS: Department of Visual Arts (<http://visarts.ucsd.edu>)

EI: Los Alamos/UC San Diego Engineering Institute (<http://www.jacobsschool.ucsd.edu/EEI>)

Calit2: California Institute for Telecommunications and Information Technology (<http://calit2.net>)

SDSC: San Diego Supercomputer Center (<http://www.sdsc.edu>)

SOM: UCSD School of Medicine (<http://som.ucsd.edu>)

CISA3: Center of Interdisciplinary Science for Art, Architecture, and Archeology (<http://cisa3.calit2.net>)

NEES: Network for Earthquake Engineering Simulation Consortium Inc. (<http://www.nees.org>)

## 8. Resources and Websites

IGERT.org  
<http://www.igert.org>

IGERT TEECH Website

UCSD Graduate Student Handbook  
<http://ogs.ucsd.edu/StudentAffairs/handbook/Pages/default.aspx>

## **9. NSF Acknowledgement Section**

Any published material related to IGERT should include an acknowledgement section (papers, posters, slides, flyers) as well as the NSF logo (posters, slides, flyers). The acknowledgment can read:

“This work was supported by the National Science Foundation under IGERT Award #DGE-0966375.”

OR “This work was supported by the National Science Foundation under IGERT Award #DGE-0966375, Training, Research and Education in Engineering for Cultural Heritage Diagnostics.”

Information on NSF's logo policy (yes, they have a logo policy) can be found here:

<http://www.nsf.gov/policies/logos.jsp>

[http://www.nsf.gov/policies/nsf\\_logo\\_standards.pdf](http://www.nsf.gov/policies/nsf_logo_standards.pdf)

## **10. Appendices**

Appendix A – White Papers

Appendix B – Mini-Grants

Appendix C – Internships

Appendix D - Sample Course list

Appendix E – Internship samples and contacts

## **IGERT Handbook Appendix B Mini-Grants**

Mini-grants serve to promote high quality research and to provide students with experience in the practical side of research -proposal writing. You are encouraged to write and submit proposals for funding in areas related to global change, marine ecosystems and society. This funding can be used to supplement a current project or to engage in a new project. Team or group submissions are encouraged.

The topic of the proposal need not be related to the student's dissertation.

Two or more students may team up and generate a joint proposal on shared research. Awardees must prepare a report of their results and may be asked to provide an oral presentation on the project. Relevant IGERT faculty will work with interested students to convert their proposal into a larger proposal to a standard funding agency.

Eligibility: Students must be an IGERT Fellow or IGERT Associate at UCSD or SIO and not be expected to graduate for at least 6 months.

Proposal Contents: Cover page should contain: project title, your name, department, email id, phone number, academic advisor, email id of academic advisor, total amount requested. Maximum of 3 pages, single-spaced, 12-point times font, 1" margins (figure, equations, and references are included in this limit; however the budget and cover page are not.).

Content should include:

- Project overview or Introduction
- Research objectives or Hypotheses
- Methods
- Relationship to IGERT objectives
- Deliverables
- Relationship to thesis research
- Timeline
- 1 page budget and budget justification (maximum \$3,000)
- Literature cited

Due date:

Proposals may be submitted at any time

Proposals will be read and reviewed by the IGERT Executive Committee

Applicants will be notified of the award within 10 days of submitting a proposal, if possible.

## **IGERT Handbook Appendix C - IGERT Internships**

IGERT scholars are required to participate in an internship at another academic institution, a governmental or non-governmental organization or industry. The program is flexible concerning the timing and duration and location of these internships in recognition of the differing career goals of each student.

The motivation behind these internships is several-fold. First, time spent at a different institution can provide students with a unique opportunity to experience a new intellectual environment. Even when students are working on a continuation of the same project, they will have the chance to interact with people who will offer new perspectives. Second, many of these internships will be available at institutions that offer expertise complementary to that available at UCSD. Thus, students will have the opportunity for training in a broader array of areas relevant to the IGERT theme than would be possible at any single institution. Third, these internships will provide perspectives on career opportunities and may help establish valuable professional contacts. Research internships in industry will provide professional training, experience with diverse and exposure to non-academic career options.

In most cases, these research internships will develop naturally from existing collaborations between IGERT faculty and those at host institutions. In general, we anticipate that these internships will take place once a student has advanced to candidacy and is underway with their thesis work (i.e. sometime after their second year in residence). It is the responsibility of the student and the faculty advisor to make arrangements for these internships. These arrangements must be approved by the IGERT executive committee.

Internships should be outlined in a brief proposal stating the objective and describing the project, location, dates and budget estimate. It should be detailed enough to provide some scientific questions or hypotheses to guide the work or provide a framework for the efforts along with some specific goals. Funding may not exceed \$6,000 including travel cost, per diem and costs for lab fees and supplies. Fees and supplies must be detailed in the budget.

Students are required to submit a brief report on the results of their internship experience within 30 days of return. Suggested Format:

Date of Proposal  
Student Name  
Curricular Group  
Email, phone  
Advisor Name & email  
Internship Institution - Name & Location  
Institution advisor/contact  
Internship Objective  
Internship Description  
Timeline  
Budget