Office of INTERNATIONAL PROGRAMS

Study Abroad General Education Grant Proposal

General Information

Nicole Radziwill
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Rank/Title

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Course Proposal

GSCI 161 – Science Processes (1 cr.)
GSCI 162 – Science of the Planets (2 cr.)

Title of proposed course(s)

Noordwijk, Netherlands
***Münster, Germany**
Berlin, Germany
Nordlingen, Germany
***Munich/Garching, Germany**

Location—city(ies), country(ies), region(s)
*= primary locations in which course will be conducted

Brief course description(s)

Science Processes, GSCI 161, emphasizes science process skills, covered in 8 modules that span the following topics: 1) observation, 2) classification, 3) measurement and calibration, 4) hypothesis testing, inference and prediction, 5) experimentation, 6) simulation and modeling, 7) communication and graphing and 8) consensus. The course is designed to address the first of the “Seven Strands” for the Virginia Science Standards of Learning (SOL’s): Scientific Investigation, Reasoning, and Logic. The class will introduce core science process skills for all science disciplines in a hands-on, integrated laboratory block.

Science of the Planets, GSCI 162, explores the origin and evolution of the Solar System by comparing and contrasting the different classes of objects present (planets, asteroids, comets, stars). We will use evidence obtained through the exploration of the Solar System using telescopes, manned and unmanned missions, and other forms of remote sensing to inform our own explorations. We will examine the dynamics of our Solar System, including gravity, tides, the seasons, eclipses, and the phases of the moon (both Earth’s and other planets). This course is designed to address specific earth and space science objectives based on the Virginia Science SOLs.

If this planning visit is approved, the instructor will also explore offering ASTR 120 (Solar System) concurrently for students pursuing Cluster Three, Track I.

Benefit statements: please attach (1) a one-page statement about the pedagogical benefits of teaching the course in the proposed location, (2) a one-page statement explaining how the course will meet the learning objective of the proposed cluster, and (3) a one-page Summary of the proposer’s experience with and possible contacts in the destination country.

Planning Trip Budget Summary *(Please itemize on the following page)*

Total planning trip expenses requested $ 4588.00

Signatures

Instructor(s) ____________________ *Date* __________

Department Chair/Unit Head ____________________ *Date* __________

College Dean/Division Head ____________________ *Date* __________

____________________ __________

Budget Information

Planning Trip Costs ***(HIGH ESTIMATES PROVIDED)***

Travel $ 1535.00

Airfare $ 1100.00

Ground transportation (including airport transfers, here and abroad; travel by train/bus/taxi/boat) $ 435.00 (Railpass)

Living Expenses *Refer to U.S. State Department per diem rates at http://aoprals.state.gov* $ 2953.00

Meals ($ 148 X 7 days)
(Münster, DE @2 days x $161 M&IE) +
(Berlin, DE @2 days x $149 M&IE) +
(Munich, DE @3 days x $145 M&IE)
$ 1055.00

Lodging ($ 264.29 X 7 days)
(Münster, DE @2 days x $261) +
(Berlin, DE @2 days x $268) +
(Munich, DE @3 days x $280)
$ 1898.00

Other (e.g., telephone, Internet access, postage) $ 100.00

Registration Fees $

Other (specify) $

TOTAL MAXIMUM PLANNING TRIP COSTS $ 4588.00

Have you received OIP or JMU support previously for international program development or travel? ☐ Yes ☐ X No

If yes, list grant type and date of most recent award.

Please note that you will be responsible for your own pre- and post-trip paperwork:
Travel Authorization Form
Travel Reimbursement Voucher

You will find the forms, instructions, and examples in the Travel and Forms sections of the Accounts Payable site.

PEDAGOGICAL BENEFITS OF TEACHING
GENERAL EDUCATION ASTRONOMY IN GERMANY & THE NETHERLANDS

While the US provides leadership in cosmology, space-based observational astronomy, and ground-based exploration of galactic and extragalactic sources, Germany and the Netherlands are recognized as leaders in the advancement of planetary science. By leveraging the resources and personnel of institutes and facilities at the forefront of planetary science research and instrumentation, this program will provide students with an up-close and personalized opportunity to see how real interdisciplinary research is done by real scientists. The pedagogical benefits of delivering these courses in this environment include the following:

- The proposed course trajectory starts with in-class exercises the first week before moving to inquiry-based learning at research and development sites abroad. This ensures that each concept covered in GSCI 161 (e.g. observation, measurement, experimentation, modeling) is examined from the perspective of how a real institution uses those processes, independently and in conjunction with one another, to satisfy their science goals and mission.
- The students will meet and get to know *real scientists* who use science processes every day in their own work to advance our understanding of planets and the planetary environment. The students will be introduced to women and minority scientists as well. (This personal experience will help them understand that scientists are real, interesting, down-to-earth people who don't walk around in lab coats with their heads in the clouds.)
- The course will use inquiry-based learning to relate science processes to how they were used to make discoveries and create new knowledge. At each site that the students visit, they will answer questions that relate one or more of the eight science processes covered in GSCI 161 to the actual investigations that are ongoing at the facility. How did the researchers at this site apply science processes (GSCI 161), and what did they learn about planets or planetary bodies in doing so (GSCI 162)?
- Classroom-based lectures, videos and discussions on GSCI 162 topics will be followed by exposure to real people and research programs that use that information. For example, they will learn about impact craters at the Institut für Planetologie in Münster from Dr. Carolyn van der Bogert, an internationally recognized expert in impact craters, and then have the opportunity to see an impact crater and some numerical simulations by visiting Ries Crater in Nordlingen.
- There will be additional benefits for IDLS students who plan to become teachers. For example, by participating in the DLR School Lab(*) at Oberpfaffenhofen, students will be able to compare and contrast teacher education in Germany with what they have been exposed to in the US. (*=http://www.dlr.de/schoollab/en/desktopdefault.aspx/tabid-1994/2862_read-4425/)
- The students will be exposed to a highly interdisciplinary and international research environment, where scientists, engineers and technicians from many countries must come together and overcome language and cultural differences to work together harmoniously.
- Because English is the official language of scientific technical communication in Germany and the Netherlands, the students will be able to appreciate the scientific aspects of the facilities and sites they visit without being hindered by language issues.

I've led two semesters of both GSCI 161 and 162 face-to-face, offered GSCI 162 as an independent study, and will conduct both as blended courses in May 2012. I feel that JMU will provide many benefits to students by delivering these courses in an environment where science processes are so fundamentally embedded into active, fruitful research environments. Additionally, I am confident that I can help students achieve the learning objectives for the courses comfortably (and with excitement and invigoration!) in the destination countries.

HOW CLUSTER THREE LEARNING OBJECTIVES WILL BE ACHIEVED
BY TEACHING THESE COURSES IN THESE LOCATIONS

GSCI 161 Science Processes (1 cr.) and GSCI 162 Science of the Planets (2 cr.) are co-requisites in Cluster Three, Track II. **General Education, Cluster Three learning objectives pertinent to both GSCI 161 and GSCI 162, and how these objectives will be uniquely satisfied in the destination countries, include:**

- **Describe the methods of inquiry that lead to mathematical truth and scientific knowledge and be able to distinguish science from pseudoscience.**
    - Students will be introduced to an extremely broad array of methods of inquiry, including (but not limited to): predicting phenomena using theory and evaluating those predictions with space-based remote sensing at Uni Münster, terrestrial remote sensing at Oberpfaffenhofen (in particular, infrared measurement for planetary remote sensing and radar for assessing distance at solar system scales) and ESO (radio astronomy); instrumentation deployed via space missions at ESA ESTEC; and computer modeling (understanding the process and geological impacts of the Ries Crater event). The differences between science and pseudoscience will be examined through discussions of the hypothesized Nibiru collision, the Moon landing conspiracy, and astrology.
- **Use theories and models as unifying principles that help us understand natural phenomena and make predictions.**
    - By discussing dwarf planets and the case of Pluto (through Mike Brown's book *How I Killed Pluto and Why It Had It Coming*), students will understand how theories and models of what planetary orbits are supposed to look like – versus what they actually do look like through observation – lead to new knowledge about natural phenomena. At ESO, students will meet a research group studying Eris, the newly discovered dwarf planet that spawned the debate to reclassify Pluto in 2006.
- **Recognize the interdependence of applied research, basic research, and technology, and how they affect society.**
    - ESA ESTEC conducts applied research, DLR Institute for Planetary Research conducts basic research, DLR Oberpfaffenhofen conducts applied research and technology development, and ESO does all three. Offering GSCI 161/162 in these countries and by introducing students to these facilities provides a very strong basis for helping students understand the similarities and differences between each of the approaches.
    - Furthermore, since technology development for planetary research often aligns with new innovations for non-astronomical applications that benefit society, students will be asked to critically examine how Deutsches Museum (Munich) exhibitions explain this social context.
- **Illustrate the interdependence between developments in science and social and ethical issues.**
    - An excursion to Ries Crater in Nordlingen will provide students with an excellent opportunity to discover how different disciplines in science (astronomy and geology) can provide information to inform each other, thus leading to new knowledge.
    - A visit to the Deutsches Museum in Munich on the day before the final exam will help provide the link between recent advancements in planetary science in Germany, and the social and ethical ramifications and issues associated with the developments (described in the museum's exhibits).
- **Use graphical, symbolic and numerical methods to analyze, organize and interpret natural phenomena.**
    - At each site, the students will be exposed to ground-based, space-based and in-situ measurements and the methods real scientists use to analyze and present that data in science communication.
- **Discriminate between association and causation, and identify the types of evidence used to establish causation.**
    - Questions assigned to students to answer during each site visit will include inquiry into causal relationships and how experiments have been used by researchers to establish them.
- **Formulate hypotheses, identify relevant variables, and design experiments to test hypotheses**.
    - Questions assigned to students to answer during each site visit will include inquiry into identification of variables, identification of hypotheses, and association of particular methodologies used to test them.
- **Evaluate the credibility, use, and misuse of scientific and mathematical information in scientific developments and public-policy issues.**
    - Questions assigned to students to answer during each site visit will include inquiry into how information was used and maybe misused, understanding the path of scientific progress even though it is imperfect and iterative, and exploring how scientists view their link to public policy issues.

PROPOSER'S EXPERIENCE WITH COUNTRY; ASTRONOMICAL FACILITIES; CONTACTS

I am a dual US-German citizen. My father came to the US from Germany before I was born, so I was raised in the US in a multi-cultural household where both German and English were spoken. German culture has been a part of my own culture since I was born, so I am very comfortable in the country and around the German people. I also worked in Amsterdam for a month in 2000, and have traveled extensively in Germany for both business and pleasure, including many visits to ESO in Garching for collaborations and scientific meetings.

1. Institut für Planetologie, Westfälische Wilhelms-Universität – Münster

Merit of Student Visit to Facility: Uni Münster has one of the largest planetary science institutes in Germany, including one of the most extensive meteorite collections in the world. The students will attend lectures and Q&A sessions with planetary scientists and geologists who will share information about their careers and their research.

Contacts: My contacts are Dr. Harald Hiesinger (one of the Directors) [1] and his wife, Dr. Carolyn van der Bogert, Research Associate [2]. I have known Carolyn since we lived together at the North Carolina School of Science and Mathematics in Durham, NC from 1990 to 1992. I have been friends with Harry since he met and married Carolyn in the late 1990's.

[1] http://www.uni-muenster.de/Planetology/people/hiesinger/harald_hiesinger.html
[2] http://www.uni-muenster.de/Planetology/people/carolyn_van_der_bogert/carolyn_van_der_bogert.html

2. **European Southern Observatory (ESO)** – Garching/Munich

Merit of Student Visit to Facility: ESO is a research hub that serves as the nexus for planetary research using the telescopes they design, build and deploy in Chile, Technische Universität München, Max-Planck-Institut für extraterrestrische Physik, and Max-Planck-Institut für Physik. In addition, ESO has a very strong Education and Public Outreach department that specifically targets high school and general education undergraduate students in their programs.

Contacts: My primary contacts are Dr. Adrian Russell and Dr. Gianluca Chiozzi. Russell is the head of the Directorate of Programmes and reports to the Director General, who is the overall leader of ESO. I worked with Russell for nearly 10 years at the National Radio Astronomy Observatory (NRAO) before he moved to Germany to take his ESO position, and in addition, our families spent 4 years as next door neighbors in Charlottesville, Virginia. Chiozzi has been one of my associates for 10 years and a collaborator for 3 years, and co-chairs with me for the SPIE Software and Cyberinfrastructure for Astronomy conference. I also have several other contacts throughout the organization, including Michele Peron (Head of Software Development) and Fernando Comeron (Head of Data Management).

3. DLR German Aerospace Center, Institute for Planetary Research – Berlin

Merit of Student Visit to Facility: This DLR institute [1] plans and executes research based on planetary remote sensing, in-situ measurements from spacecraft missions, and theoretical modeling and lab experiments. It is one of the only planetary science institutes in the world that combines all of these diverse approaches to study planets, moons, asteroids and comets.

Contacts: My contact Dr. Harald Hiesinger from Uni Münster has agreed to introduce me to his good friend and collaborator Dr. Tilman Spohn, Head of the Institute, during my visit.

[1] http://www.dlr.de/dlr/en/desktopdefault.aspx/tabid-10252/

Contacts at the other sites (e.g. Oberpfaffenhofen) will be made during the planning trip supported by this grant, facilitated by friends and association whenever possible.