OCEAN EDUCATION AT NSF: DIRECTIONS & PRIORITIES

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Policy Context

- OSTP Reports
  - PCAST STEM Education Reports (2010, 2012)
  - Federal STEM Education 5-Year Strategic Plan (CoSTEM, 2013)
- NRC Reports
  - Role of Comm. Coll. (2012); Future Earth Science Workforce (2013)
  - Sea Change: 2015-2025 Decadal Survey of Ocean Science
- Geoscience Community Reports
  - AGI Status of the Geoscience Workforce (2014)
  - Summit on the Future of Undergraduate Geoscience Education (2014)
  - ORAP report to NOC on ocean education (2013)
- NSF Strategic Planning Documents
  - NSF Strategic Plan 2014-2018
  - GEO Advisory Committee (AC/GEO) reports
  - Improving Undergraduate STEM Education (IUSE) framework

CoSTEM 5-Year Strategic Plan (NSF)

- **Undergraduate Education**
  - Identify & broaden implementation of evidence-based practices & document their impacts on learning & retention
  - Improve STEM Ed support at 2-year colleges & create bridges between 2-year and 4-year programs
  - Incentivize & support university-public-private partnerships to provide relevant & authentic STEM learning experiences
  - Address high failure rates in gatekeeper introductory math classes
- **Graduate Education**
  - Recognize & financially support students with high potential for making contributions in STEM careers
  - Help prepare students in areas critical to the Nation, including opportunities to develop the future Federal agency workforce
  - Continue & enhance mechanisms for evaluating the impact of gra fellowships

Improving Undergrad. STEM Education (IUSE)

- Cross-NSF initiative to offer a coherent suite of funding opportunities
- Focus is on building & using the evidence base for improved STEM teaching & learning
- Three "pillars"
  - Improve STEM Learning & Learning Environments
  - Broaden Participation & Institutional Capacity for STEM Learning
  - Build the Professional STEM Workforce for Tomorrow
- Framework for IUSE initiative acknowledges:
  - Linkages between STEM education research & education practice
  - Disciplinary communities are not all at same stage in their evolution
  - Disciplinary scientists have an important role to play in catalyzing change & adoption of best practices in their communities
- Budget (FY15/FY16):
  - EHR ($84M / $120M); ENG ($6.0M / $6.0M); **GEO ($10.9M / $6.0M)**;
  - BIO ($2.5M / $2.5M); CISE ($2.0M / $0)

IUSE Funding Opportunities

- ***IUSE: EHR***
  - Consolidation of TUES, STEP & WIDER programs
  - Program Solicitation NSF 14-588 has 2 tracks & 2 funding levels
    - Engaged Student Learning (Track 1)
    - Institutional & Community Transformation (Track 2)
    - Exploration Projects, Design & Development Projects I & II

- ***IUSE: Pathways into Geoscience (GEOPATHS)***
  - Program Solicitation NSF 15-526 has 2 tracks
    - GEOPATHS-EXTRA
    - Extra-curricular experiences for cohorts of students that foster skills development, increased career awareness & stronger engagement
    - GEOPATHS-IMPACT
    - Institutional partnerships that promote retention of students in the geosciences at critical junctures, especially between 2-year and 4-year institutions and/or between Minority-Serving Institutions and 4-year institutions with geoscience degree programs
  - Up to $500K total; up to 3 years of funding

NSF Graduate Education Initiatives

- **Graduate Research Fellowship Program (GRFP)**
  - Graduate Research Internship Program (GRIP) – engage in mission related research with partner agencies (NOAA, ONR) [NSF 14-084]
  - Graduate Research Opportunities Worldwide (GROW) – travel allowance for 2 to 12 months of international research [NSF 14-121]
- **Graduate Traineeship Programs**
  - Integrative Graduate Education and Research Traineeship (IGERT) replaced by new NSF Research Traineeship (NRT) program in FY15
  - NRT includes an *Innovation in Graduate Education* track
  - GEO's NRT budget: $6.63M (FY15) and $4.43M (FY16)
- **Graduate Research Assistantships**
  - Currently 80% of NSF support for Grad Students
  - Internal review is considering pros & cons of RA mechanism for providing students with needed skills

But, Do RA's Fully Prepare Graduate Students?

- Content mastery in their discipline
- Critical thinking skills
- Training in ethics & Responsible Conduct of Research (RCR)
- Preparation for a variety of career paths, not just academia
- Development of non-research skills as well as research skills
- Emerging drivers of changing skills needed:
  - Extreme longevity; rise of smart machines & systems; computational world; new media ecology; super-structured organizations; globally connected world
- Key skills needed:
  - Sense-making; novel & adaptive thinking; social intelligence; transdisciplinarity; new media literacy; computational thinking; cognitive load management; cross cultural competency; design mindset; virtual collaboration

- From the "10 Skills for the Future Workforce" report

NSF Broadening Participation Initiatives

- *Inclusion across the Nation of Communities of Learners that have been Underrepresented for Diversity in Engineering and Science (INCLUDES)* initiative
  - New 6-year NSF-wide activity proposed in FY16 budget request
  - Expect to pilot two models
    - **Network Pilot** – collective impact via professional and social networks & use of effective technologies
    - **Youth Empowerment Pilot** – engaging youth in STEM through innovative, discipline-specific initiatives

GEO's Education Priorities

- Increase Undergraduate Exposure to & Enrollment in the Geosciences
- Prepare a Capable Geosciences Workforce
- Broaden Participation of Underrepresented Groups
- Promote Public & Community-based Science to Improve Public STEM Literacy and Decision-making, and to Advance the Geosciences
- Promote Use of Community Resources for Both Research & Educational Purposes

  - From "Dynamic Earth: GEO Imperatives & Frontiers 2015-2020" (AC/GEO, 2014)

Implementing GEO's Priorities

- **GEO's Education Programs**
  - *Geoscience Education (GeoEd)* program ended in FY13
  - *GLOBE* program funding ($1.1M) continues
  - *IUSE: GEOPATHS* program initiated in FY15
  - Divisional REU, Postdoc Fellowship, CAREER programs continue (mostly)
  - Limited discretionary funding to support geoscience education workshops & pilot community-science activities

- **GEO's Broadening Participation Programs**
  - *Opportunities for Enhancing Diversity in the Geosciences (OEDG)* program ended in FY13
  - FY14 Supplemental Funding ($6.4M) was provided to existing awards, with an emphasis on broadening participation and augmenting/increasing REU Sites
  - Piloting a new *PArtnerships for Geoscience (PAGE)* track in the *Tribal Colleges and Universities Program (TCUP)* [NSF 14-572]
  - FY16 INCLUDES budget request for GEO is $2.44M

NSF/OCE Education Activities

- Proposed FY16 OCE Education budget is $2.73M
  - This is a 45.2% reduction over FY15
  - REU support being increased to $2.2M (+$0.2M)
  - OCE postdoctoral program being terminated
  - Other disciplinary ocean education efforts reduced by $1.0M (to $0.5M)
- Center for Coastal Margin Observation and Prediction (CMOP) is being retired
- OCE support for the Center for Dark Energy Biosphere Investigations (C-DEBI) is continued
- Broader Impacts activities in research grants

REU & CAREER

- REU Sites or Supplements
- >50% of Site students must be from institutions with limited research opportunities
- Recruitment of URM & males still an issue for OCE Site programs

- CAREER supports a pre-tenure young scientist
- Five-year award
- Requires both a science plan & an education plan
- 38 OCE awards (2003-2014)
- Candidate pool for PECASE awards

Using Broader Impacts for Education

- Opportunity to support ocean education through the Broader Impacts activities of research projects

- Effective Broader Impacts activities:
  - Build on known best practices from STEM education research
  - Address important geoscience education goals
  - Are designed for successful implementation
  - Include a plan for documenting impacts & outcomes
  - Involve appropriate expertise & financial support
  - Consider how this activity scaffolds to education ‘next steps’ and/or post-grant sustainability issues

Other Ways to Fund Ocean Education

Pre-College & Informal Learning Audiences

- Research Experiences for Teachers (RET) supplements
- EHR Programs (DRK-12, ITEST, AISL)
- STEM+Computing Partnerships program [NSF 15-537]
  - Focus on development of computational thinking skills in K-12 students, through integration of STEM concepts
  - Opportunity to use big Earth systems data & modeling for education

New Initiatives in FY16 Budget Request

- PREEVENTS
  - Prediction of and Resilience against Extreme EVENTS (successor to Hazards SEES program)
- INFEWS
  - Innovations at the Nexus of Food, Energy, and Water Systems (can include marine ecosystem services)

Take Home Messages

- NSF is moving toward more agency-wide educational initiatives, at the expense of Directorate-level programs
- Disciplinary communities need to be more engaged in promoting the use of education & diversity best practices
- There are funding opportunities at NSF that can support ocean education activities
  - But, PI's need to understand there is a shifting emphasis away from "implementation projects" toward "education research" projects
- Institutional partnerships that leverage existing research & education infrastructure are desirable, if sustainable
- Given budgetary constraints, more strategic utilization of broader impacts activities to support ocean community's education priorities should be cultivated