Outcomes of 2019 Heads/Chairs/Graduate Program Directors Summit & implementation successes

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Opportunities for developing skills during graduate school

Where to best develop competencies?

- ***Research***
- ***Graduate Coursework***
- ***Co-curricular activities***
  - **Short Courses, online courses; certificate programs, invited presentations, workshops, etc.**
  - **Departmental activities, clubs, outreach programs, internships, professional organizations, public engagement, etc.**

- **Technical skills & core disciplinary knowledge**
- **Written & oral communication**
- **Critical thinking & problem solving**
- **Systems thinking**
- **Computational & quantitative skills**
- **Big data – Data Analytics & Data Management**
- **Project & time management, team work, leadership**
- ***Case studies – within courses & entire courses***
- ***Service - learning courses***
- **Ethical (research) behavior, standards of practice, biases & equity in science & work force**

Departments & Students take ownership

Need for Integration

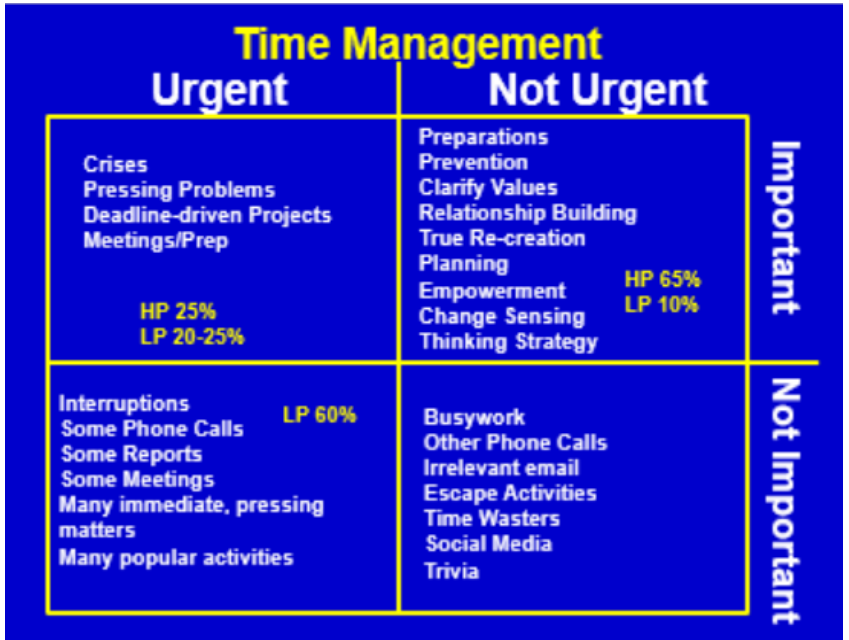
- **What distinguishes a PhD/strong researcher?**
  - **A deep technical dive into one subject**
  - **Ability to discover, own, and solve a problem independently**
  - **High level of creativity and innovation**
  - **Ability to create new knowledge**

- **Need to integrate these identified skills without losing the strong research emphasis**
- **Make many of the non-core research skills part of program culture**

Heads/Chairs analysis:
Where to best develop competencies? *Research*

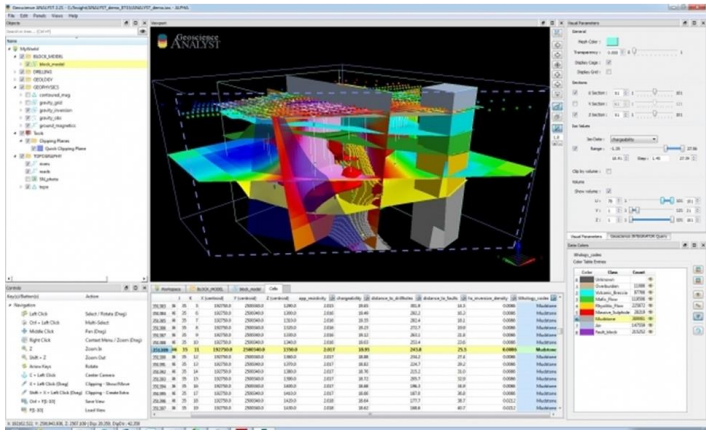
- **Focused disciplinary & technical knowledge**
  - **Field and/or lab skills**
  - **Computational skills, Big data – Data Analytics, Data Management**
- **Communication: Written & Oral communication**
  - **Thesis/dissertation, publications, proposals & conference presentation**
  - **Presentations to research group, department, undergraduate classes**
  - **Writing press releases before the full proposal & publications -- societal impact, diverse audiences**
- **Critical Thinking & Problem solving**
  - **Reading & evaluating literature**
  - **Identifying reliable data sources**
  - **Analyzing & evaluating data/results**
  - **Characterizing, managing, communicating uncertainty**
  - ***Learning to formulate problems & solutions; recognizing societally important problems***
- **Project & time management -- dissertation/thesis research project**
- **Team work (as part of research group)**
  - **Project & time management**
  - **Conflict resolution**
  - **Diversity sensitivity**
- **Ethical (research) behavior & standards of practice**
- **Learn to take calculated risks, manage criticism & failure**

- **Organizational Management Skills**
  - **How to run a meeting (agenda, time management, relevance, etc.)**
    - **Students rotate to run lab meetings (or TA meetings)?**
  - **Give concise and organized communications to a group**
    - **AGU-style talks; elevator speeches**
  - **Exposure to a chain of command and business culture**
    - **Foreign in academic settings but need to explore**
  - **Time management for self and in interaction with colleagues**



Where to best develop competencies? *Graduate Course Work*

- Technical skills & core disciplinary knowledge
  - Integrate systems thinking
- Written & oral communication
  - Need intentional instruction & significant feedback
  - Abstracts, papers, 1-pagers, presentations
  - Writing proposals as the class project -- integration of data from the literature, identify problem & societal impact, project management plan, budgeting, & communication
  - Writing peer review (works better than faculty editing)
- Case studies – within courses & entire courses
  - Synthesis, data analysis, decision making, & communication
  - Characterizing, communicating uncertainty
  - Identifying problems & sufficient solutions
- Computational skills, Big data – Data Analytics & Data Management
  - Include large datasets in classes
- Project & time management
- Team work -- with instruction & expectations for group interactions
- Service - learning courses
  - Identifying problems, sufficient solutions, communication, team work, diverse communities
- Direct discussion of ethics, standards of practice, biases & equity in science & work force



Heads/Chairs:
How can we make these opportunities available throughout the graduate experience?

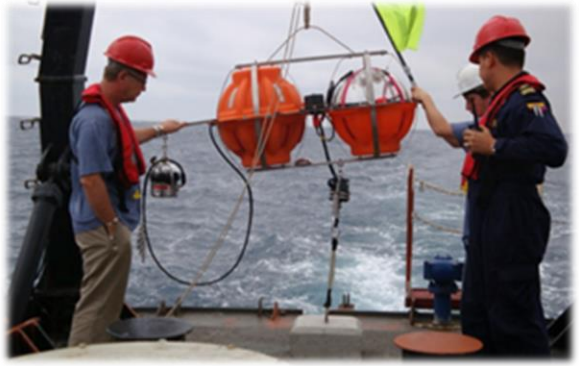
- Deliberate planning & coordination of graduate coursework to include competencies
- Electives or special topics courses
  - Big data, coding, statistics
  - Science communication
  - Project management
- Build open & easily usable databases for students in all fields
- Integrate skills & interests in big data, coding, scientific communication into theses & dissertations
- Reevaluate qualifying/comprehensive exam within the context of broader expectations
  - Press release
  - 3 minute thesis presentation
  - Project plan & budget
- Define expectations & mentoring plan (i.e. paper authorship, timeline, etc.)

- ***Individual development plan (formalize?)***

Where to best develop competencies? *Co-Curricular*

Departmental activities, clubs, outreach programs, internships, professional organizations, public engagement, etc.

- Leadership & project management skills
- Oral communication
  - Presentations, brown bag talks, and competitions
  - Diverse audiences
- Written communication
  - Reports, fliers, news articles
- Interpersonal skills
  - Conflict Resolution,
  - Ability to work with people who are different & from different cultures
- Teamwork with diverse groups
- International experiences
- Field Experiences
- Peer mentoring/feedback, informal faculty/staff mentoring
- Entrepreneurship



Other co-curricular options:

Short Courses, online courses; 1 credit courses, non-departmental courses, certificate programs, presentations, etc.

- Career development or geoscience professionalism courses
- Alumni, returning interns & other “real world” speakers
- Communicating to different audiences (Toastmasters, etc.)
- Teaching training (NAGT, university Centers for Teaching Excellence, TA training workshops)
- Business/Commercial Acumen/Leadership
  - Within existing courses – Economic Geology, Petroleum & Mining Geology, Environmental Geology, Hydrogeology
  - Business schools, alumni, industry collaborators, etc.
  - Dual degrees
- True Teamwork (not group work or collaboration) – partnerships with industry, agencies & societies
  - Corporate challenge in partnership with corporations and government partners
  - Team-based cross-disciplinary, longer-term projects for student groups to work on together (e.g. AAPG’s Imperial Barrel)
- Case studies - involve industry partners; industry retirees
- Ethics (Institutional training)
- Professional development
  - Scientific writing, scientific methods, presentation boot camp

Workshops & Websites

- Diversity, equity, and inclusion training
- Mentorship training for current and future faculty
- Standards of professional practice
- Conflict management
- Time management
- Pedagogy
- Grant Writing
- Breadth of career tracks available for geoscientists
- For faculty: skills & competencies needed by students for career success
- For Students: resources available on campus & through professional societies

Earth Educators' Rendezvous
Nashville, TN, July 15-19, 2019
View the Program | Search the Program

Hydrology

Career Compass Geosciences

This career compass provides options, tips, suggestions, and strategies for how a student can obtain critical skills, experiences, and competencies in order to launch their geoscience career based on their academic standing. The content herein is based on data from the U.S. Bureau of Labor Statistics, interviews with personnel in the occupation, and research on available student opportunities.

Job Summary

Hydrologists study how water moves across and through the Earth's crust. They use their expertise to solve problems in the areas of water quality or availability. Hydrologists work in offices and in the field. In offices, hydrologists spend much of their time using computers to analyze data and model their findings. In the field, hydrologists may have to wade into lakes and streams to collect samples or to read and inspect monitoring equipment.

Build Grow Connect

Undergraduate

- Clubs, student government, or geoscience professional societies
- Hone skills through courses, community involvement, and conference presentations
- Geoscience professional society conference
- First Aid/ AED/CPR training
- OSHA HAZWOPER training
- Geologist in Training Certification (ASBOG Fundamentals Exam)
- Geoscience internship with a non-profit, for profit organization or company, research institution, or federal agency
- Degree in earth science, geosciences, or other natural science major
- Proficiency in using and understanding GIS
- Writing class outside the discipline (business or environmental law)
- Course work in math, chemistry, or microbiology
- Research experience
- Field experience
- Write a senior thesis

Graduate/Master's

- Present research at conference
- Publish research
- Events, activities, and technical sessions at professional society conference
- Departmental committee, clubs, geoscience professional societies

Also applicable at Ph.D. level

- First Aid/ AED/CPR training
- OSHA HAZWOPER training
- Geologist in Training Certification or Professional Geologist license (ASBOG Fundamentals of Geology Exam and/or the Practice of Geology Exam)
- Geoscience internship with a non-profit, for profit organization or company, research institution, or federal agency
- Degree in geosciences
- Coursework in advanced math
- Map creation software or groundwater modeling software
- Master's thesis related to groundwater/surface water interaction

Ph.D./Post-doc

- Develop interpersonal skills
- Present complex scientific concepts to nontechnical audiences
- First Aid/ AED/CPR training
- OSHA HAZWOPER training
- Geologist in Training Certification or Professional Geologist license (ASBOG Fundamentals of Geology Exam and/or the Practice of Geology Exam)
- Geoscience internship with a non-profit, for profit organization or company, research institution, or federal agency
- Degree in geosciences
- Coursework in advanced math
- Map creation software or groundwater modeling software
- Take a more focused approach in a discipline related to your career aspirations
- Dissertation topic(s) related to groundwater/surface water interaction

Symbol Key

- Attend
- Communicate
- Network
- Participate
- Leadership
- Internship
- Scholarship
- Fellowship
- Academics

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Individual Development Plans (IDPs)

Customized roadmap for professional training & goals

- **Skills assessment: What skills do I currently have?**
  - **Research, Professional Time Management, Interpersonal, Management & Leadership**
- **Career Aspirations – what career pathways interest me? What do I like to do?**
- **Desired Skills – setting goals for the skills I want**
  - **Specific & Sensible, Measurable, Action-oriented, Help needed, Time-bound**
- **Professional Development – what support can I take advantage of?**

Reflect on self-assessments & career aspirations / professional values

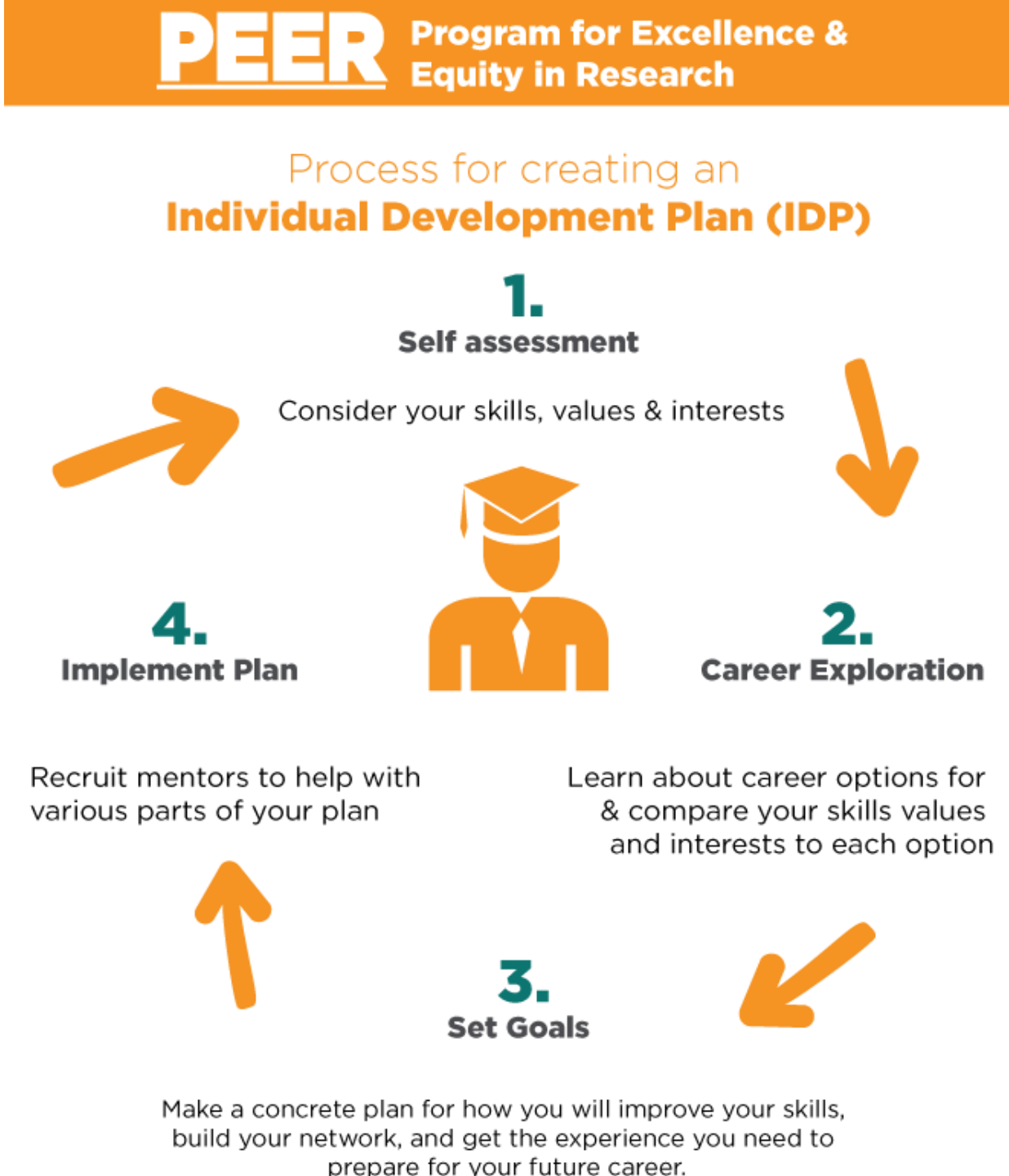
See AAAS Science Careers: my IDP (https://myidp.sciencecareers.org/)
https://www.purdue.edu/science/graduate/idp.html
https://grad.wisc.edu/professional-development/individual-development-plan/
https://www.feinberg.northwestern.edu/sites/ctmh/docs/idp-worksheet.pdf

Preparing students for future success

- Inform students of skills & knowledge needed for wide variety of careers
- Provide opportunities for development of these competencies
- Mentor students throughout program
  - *Accept value & importance of non-academic careers*

The Program for Excellence & Equity in Research (PEER)

- **Initiative to increase the number of exceptional underrepresented students graduating with doctoral degrees in STEM disciplines**
- **University of Tennessee, Knoxville.**



2019 Heads/Chairs Summit Action Plans: Implementation and Successes

- Broad support; Everybody onboard with need to improve these aspects of grad education
- Faculty very supportive; grass roots response to changing workforce landscape
- Mini retreat; Full faculty retreat
- Individual faculty involvement; Senior faculty less resistant to change
- Slowing process to get collective buy-in
- Trial IDPs to show it works
- Having students see how helpful IDPs were for them as a reflection tool and in aiding communication with their advisers
  - and faculty see that the students want this for their own accountability
- Increased communication between advisors and advisees; Everyone loved PhD assessments
- Convincing upper administration that department was worth investment

IDPs & Mentoring

- **Mentoring**
  - **New mentoring program – 1st year students – several mentors – faculty, research staff, senior students**
  - **Each grad student meets with their committee twice a year; gives broader mentoring**
  - **Augmented mentoring activities by developing an alumni mentoring program for current students**
  - **Developed TA agreements and revamped onboarding of new graduate students to ease inequalities in mentoring across the department and helps students develop a cohort.**
- **Individual development plans (IDPs)**
  - **IDPs now a formal part of the intro course for all grad students; most current students have completed one**
  - **Upper level students complete IDP & write a reflection about their strengths and what areas they wish to focus on the coming year.**
  - **MS and PhD students develop IDP through a discussion with their advisor**
  - **Implemented IDP's and committee mentoring for graduate students**
  - **New annual student report emphasizing IDP**
  - **Instituted IDP in 2015; still working to get all faculty to implement it**
  - **Implemented a pilot IDP program that is being tested by several of our faculty**
  - **Many students complete an IDP regularly but not as part of a formal structure**
- **Changed PhD timeline to include aspects of professional development self-assessment; drafted MS assessment**

"Summit approaches have given students/postdocs more confidence in discussion their progression planning and futures."

New Courses

- Machine learning & data analytics
  - Developed machine learning and data analytics class
  - Started experimental course on machine learning
  - Instituted an experimental course on machine learning called “Machine Learning for Atmospheric Science”
  - Instituted cross disciplinary machine learning tutorial/workshop in collaboration with other units on campus.
  - Faculty recognition that all students need to master data analytics courses

- Other new courses added
  - Remote sensing
  - Economic Geology, run in conjunction with members of our Alumni Board who work in economic geology industries - 1-2 week short course introduces graduate students to non-academic careers
  - “Social Responsibility in Atmospheric Science”
  - Environmental Rules and Regulations – covers role of science in developing rules, regulations, and legislation; engage regulatory agency personnel in course

- Additions to existing courses
  - Expanded and improved non-technical skills training in research conduct and other courses
  - Introductory Course – added lecture on universal skills required by employers; developing follow on course that will cover time management, ethics, IDPs and industry input.
  - Continue to diversify and add courses that build on hazards expertise
  - Develop and add more field-oriented learning
  - Develop training in formal grad courses for career skills beyond academic and research-oriented
  - Faculty discussing ways to specifically incorporate some of these skills into their courses

Breakout Session #2: Ways of developing skills & mentoring

- **What skills and competencies can graduate students develop while doing research that are important for a variety of future careers?**
- **What graduate coursework will develop the skills that students need for the future workforce? If no courses are required for the degree program, how do you incentivize faculty to offer and students to take them?**
- **What other professional experiences or external opportunities should graduate students have? Does this vary with MS and PhD students?**
- **What are effective ways to mentor students and insure they develop the skills they need for their career path? Who should be involved in the mentoring?**