

**2<sup>nd</sup> Summit on the Future of Undergraduate Geoscience Education**  
**Department Heads and Chairs**  
**January 8-10, 2016**

**BREAKOUT QUESTIONS**

**The purpose of Friday's and Saturday afternoon's breakout sessions is to discuss what you are doing in your departments, find out what others are doing, get ideas for changes you can make, and discuss how such changes can be implemented.**

**Friday Morning Breakout Questions**

*To what extent are curricula and learning outcomes (concepts, skills, competencies) in participating departments aligned with results of the first summit and employer input? Are curricular changes in motion or under consideration? What are key trade-offs in initiating/implementing such changes?*

- ❖ **Of the nine broad concepts identified by the 1<sup>st</sup> Summit and supported by the survey results and Geoscience Employers Workshop (listed below), which are not covered in your department's courses and curriculum? Which are? Why or why not?**
  - Earth as complex and dynamic system with linkages between the different systems (e.g., lithosphere, atmosphere, biosphere, etc.).
  - Deep time (including the origin and evolution of life)
  - Hydrogeology (including water, rock, and microbe interactions)
  - Natural resources (including energy)
  - Natural hazards
  - Earth materials
  - Earth structure
  - Surface processes (including relationship between landscape and process)
  - Climate change
  
- ❖ **For the concepts covered by your department's courses and curriculum, how much of the granularity provided by the Geoscience Employers Workshop is covered? (see handout) How much is covered in more than one course or in different depths? How much only in introductory courses? What, if anything, do you think is not important to cover? Does material in your department's courses focus on processes or on nomenclature and description?**
  - How can these concepts be embedded in courses you currently teach? What modifications to the course content would be needed? Are there other concepts you think need to be addressed? How can the courses you teach be modified to cover these in the depth indicated by the Geoscience Employers Workshop or would you need to revamp the offered courses? How might this be done?
  - What courses or activities in your department require use of the skills identified in the 1<sup>st</sup> Summit and supported by the survey results and emphasized by the Geoscience Employers Workshop? At what level are they used and are they used in several courses

or activities? Are they required? How can you modify courses or activities to ensure that students develop proficiency in these skills? [Note many additional questions on skills in next breakout session.]

- What concepts and skills are developed in introductory courses that are valuable for middle and high school science teachers? How can we integrate math and other sciences in introductory courses to provide future middle and high school science/math teachers geoscience examples to use in their classes?
  - Has your department already revised your curriculum and courses using a concepts/skills/competencies approach? If so, did you use the ones recommended by the Summit or others? How long ago did you do this and how successful has it been thus far?
  - How is your department making sure that students graduate with the verbal, written and listening communication skills and understanding of social science that will make them effective in their chosen careers? How do we infuse curricula with an appreciation for ethics, cultures, and personal responsibility? How much of such training (including communication) is the responsibility of geoscience departments versus the rest of the students' college education?
- ❖ **How can you assess whether students have learned the concepts and become proficient in the skills? Which of the original summit recommendations is your department already doing well? With what outcome and how measured? On which ones does your department need to improve?**
- ❖ **How do you balance the need for geoscience concepts and skills, high level qualitative and computational skills, and the liberal arts end of the spectrum that prepares citizens with a broad knowledge of the world and ability to think? What about the employers' interest in students having some insight into business and leadership training?**
- ❖ **Does your department or college/university provide career preparation? What kind?**
- ❖ **Which are the most important new ideas for your department to implement? Which are least important? What are the key benefits of implementing changes? Key risks of not implementing?**

### **Friday Afternoon Breakout Questions**

*Evidence indicates that students learn better from a variety of active-learning strategies than by traditional lecture approaches, as well as from use of real-world data and experiences that are relevant to future careers. To what extent has your department been able to embrace shifts of this nature? What do you see as opportunities and challenges in effecting such changes?*

- ❖ **Which of the teaching methods or pedagogies (flipped classrooms, blended learning, think-pair-share, retrieval practice, minute papers, concept tests, explore before learning, opportunities for reflection and refinement, team in-class exercises/discussions, inquiry based labs) are used in your department? By what proportion of your faculty? Has the faculty and students experience with these been positive? Has the change in student learning been assessed? What successes or failures have there been? What is practical for your department to implement given your department size and current infrastructure?**
- ❖ **What opportunities do your students have to work with real data to solve geoscience problems? Is this part of required or optional classes? What types of courses (subject matter)? What type of data? Are the problems ones with no clear answers? Does it involve use of “big**

**data”? Do they also do modeling and simulation of the data? Where do you get these datasets? Is finding appropriate datasets a problem?**

- Do your students have the opportunity to collect their own data, analyze it and interpret it? Do they learn what tools to use to collect data to answer different types of problems? Do they get experience solving real problems in 3D and 4D? Do they have to identify the problem and figure out what type of data to collect to answer the questions? How can this be integrated into your program or additional opportunities be created?
- What opportunities do your students have to do research, following the research process from beginning to end? Is this required?
- Do you offer entire classes (or large portions of a classes) designed around collaborative team based projects? Are projects interdisciplinary? Do the students have other opportunities to work in teams? How are the teams structured? How do we successfully teach students to work well in a team environment and to learn project management within a team setting? How can you increase the amount of team projects in your undergraduate program?

**❖ Do you have industry participation in undergraduate education – through providing datasets, guest lectures, project evaluations/presentations, or other means? If so, how did this come about? What industries hire most of your students? Which ones are located nearby?**

**❖ What strategies or incentives have been (or might be) effective in promoting the adoption of research-validated pedagogy and experiential learning in your department/program?**

- What types of experiential learning has your department tried? What has been successful and what has not? How was this assessed? What would you like to have your department try? What might work?
- How is technology used in teaching (passive visualization/observation, interactive visualization, student-driven investigation facilitated by technology with or without real-time “instantaneous” feedback, modeling and simulation, educational games) in your department? What proportion of faculty and/or classes use technology? What barriers does your department have to using technology?

**❖ What level of math is required (calculus, differential equations, linear algebra)? Is it used in geoscience courses throughout or only in upper level or elective classes? Or is it not used at all in undergraduate geoscience classes? Do the students take probability and statistics? Is this used in geoscience courses to evaluate data and work with uncertainty? Is any math and other sciences used in any introductory classes?**

- What level of computational skills do your students have? Is this developed in geoscience classes, in other science/engineering courses and applied in geoscience classes, or developed by other means? Do your students analyze large datasets? If so, in classes, research or other activities? What software do you students use and do they also learn how it works?

**❖ What type of field training and field experiences do your students have? Is it required or optional? How is technology used in field training? e.g. students develop information/data using remote sensing; students collect geological, geophysical, oceanographic or meteorological data in field; instructor provides information for use in field - e.g. maps/cross sections overlain on Google Earth, DEMs overlain on photographs, remote sensing interpretations, etc.; mapping done on tablets, IPADs or phones; geospatial data, ARCGIS or other similar software is used; virtual fieldtrips?**

- How can increased field exposure be added to your program? Can we integrate field experiences into the curricula at diverse institutions? How can collaboration between local 2YC, 4YC/universities increase field opportunities for students?
- ❖ **How do we ensure students develop critical-thinking and problem solving skills and the ability to be life-long learners? What geoscience activities lead to these skills and how can we assess our success developing these in our students?**
  - What does your department do to develop the ability for students to search and critically evaluate geoscience literature?
- ❖ **Does your institution track Student Learning Outcomes or other metrics of student success with in your department? How is this done?**

### **Saturday & Sunday Morning Breakout Questions**

*The purpose of the Saturday and Sunday morning breakout sessions is for you develop a plan for how to move own institution forward when you return home. In the breakout sessions, consider everything you discussed yesterday and learned from the panel discussions, and then discuss with your group how you think you may proceed.*

**These breakout sessions have new working groups clustered by those who most likely are facing similar issues. The questions below are designed to help in addressing potential barriers and solutions. Time is allotted for you to work individually as well. On Sunday morning, also incorporate what you discussed in the breakout session on Saturday afternoon. You are expected to submit a preliminary plan for your department before leaving on Sunday. Flash drives will be provided to capture the plans electronically.**

- ❖ What are potential roadblocks to change in your department, both internal and institutional? What are common challenges and/or challenges specific to your institution or type of institution? What actions you can take to overcome them? What is needed to motivate such changes? What kind of internal and external help would be most useful?
- ❖ How will your department make a systematic effort to improve competencies, skills, and conceptual understanding of your students in the next few years? If you have not taken this approach in developing your undergraduate curriculum already, how will you do so? What are the barriers and solutions? Is the resistance from above or below or both? If you have already done so, what additional changes need to be made because of what you have learned at the summit?
- ❖ Which of the recommendations on needed conceptual understandings and technical and nontechnical skills discussed yesterday will be the most challenging for your department? What are solutions to achieving each of these recommendations?
- ❖ What are obstacles and barriers to implementing research-validated pedagogies, experiential learning, and more use of technology in your department? How can these be overcome? Ones identified by the 1<sup>st</sup> summit include concern about annual performance, tenure, and promotion evaluations and/or student evaluations, instructional space design and teaching infrastructure, lack of knowledge of which techniques are research-validated (actually work), financial resources, lack of access to technology, culture and tradition, faculty age, lack of time and support. Which of these are problems in your department? Are there others? Are you empowered to solve these issues or does this require higher authority? Is there resistance from faculty?

- ❖ What can your department do to motivate faculty to improve undergraduate geoscience education? Does your department offer professional development for faculty teaching, rewards for innovative teaching or incentives (including release time) for developing new courses using research-validated pedagogies or courses, programs and activities involving experiential learning? Are these possible for you to offer or are there other incentives that would work better? Once such courses or activities are developed, are there incentives for faculty to keep offering them? Do you have the instructional infrastructure and technology to offer such courses? If not, what would it take to do so? Are there institutional requirements for faculty that make experiential learning courses, programs, activities an extra burden? Is effective teaching an important hiring criterion, and important for tenure, promotion, and salary increases?
- ❖ What types of resources, materials or next steps would help support and encourage pedagogical reforms and development of curricula focusing on concepts/skills/competencies? What external actions would be most helpful (i.e. from NSF, professional societies, industry, geoscience community)? Are there formal or informal partnerships/structures (e.g., by region, institution types, and/or other) that could emerge to encourage innovation, field-testing, support, etc., at a larger scale?
- ❖ What are the most important changes you can implement in your department? What are the costs and benefits? What tactics will you use to implement those changes? What would define success in 1 year, 5 years? Have you tried to implement similar changes previously and failed? If so, why? What were the barriers? What can you do differently this time?

### **Saturday Afternoon Breakout Questions**

***Robust enrollments and broad participation of students from diverse groups benefit from best practices in recruitment, retention and, increasingly, support of transfer students from both sending and receiving institutions. To what extent does your department employ such practices? What steps might you take, and with what partners, to strengthen recruitment, retention and transfer support?***

- ❖ Given that nationally large percentages of students at 4 year colleges and universities transfer from 2 year colleges, which of the concepts and skills discussed yesterday should be covered or developed during the first 2 years of a college/university degree? For 2YCs, which do you cover or develop? For 4YCs and universities, which do you cover in the first two years? Are your methods similar? Compatible? What can each of you do to ensure that students know and develop the concepts and skills expected of students finishing their first two years of college? Are there collaborations between faculty at local institutions that you could institute that would help with these issues? Are there already cooperative arrangements between the local institutions?
- ❖ What helps students transfer successfully? What causes problems? What kinds of gaps have you experienced with transfer students or heard from your students who have transferred? Are entering transfer students treated as a separate cohort? What is done to integrate transferring students into existing cohorts? Are summer classes, online classes, research experiences, collaborative fieldtrips, or internships available for 2YC or transferring students? What pathways and strategies for smooth transitions can you implement or improve?
- ❖ What can colleges/universities do to help local 2YCs meet the needs of students planning to transfer into 4YCs and universities? What can 2YC faculty do in courses and activities to help with the transition to junior/senior level courses? Is there an alignment between curricula in local 2YC and

4YC/universities? What should 2YCs offer if for a terminal associate's degree? What type of articulation agreements do you have between 2YCs and 4YC/universities? How can central administrations work together? How can geoscientists help with coordination? What are the barriers to coordination? What has helped?

- ❖ What cultural issues and barriers have you found for minority, 1<sup>st</sup> generation, rural, and intercity students? What programs, activities or other means have you found help or don't help? What are your successes and problems? For those transferring from 2YCs, what has helped these students (either from your knowledge of transfer students or heard from your students who have transferred)? What can your department do to help students overcome these issues and barriers?
- ❖ Do you have programs specifically designed for retaining students from underrepresented groups, including 1<sup>st</sup> generation students? What are these and what has worked? Not worked? How is this measured? Are such programs available to all students at the same level or just underrepresented groups? If just the latter, do you have other programs focused on integration? Do you have different programs if the students are entering college for the first time or transferring from another institution? How might you modify what you currently do to address issues facing students from underrepresented groups?
- ❖ The 1<sup>st</sup> summit identified the following combination of elements in successful recruiting programs for underrepresented groups and first generation college students: providing financial support; reaching out to students in their communities; involving members of the community (families, high school teachers, guidance counselors), incorporating role models and mentoring. Which of these have you tried? Found successful or not successful, individually or collectively? Are there other elements you have found to be important? Are you interested in your department or institution implementing such programs? What would you need internally or externally to do this?
- ❖ Do you offer summer programs, research or field experiences, internships or other opportunities for high school students (or 2YC students)? What would motivate your department to offer these? Have you developed or do you collaborate with STEM programs for minority students at pre-high school and high school levels in your local area? In what way and how successful has this been? What are the barriers to collaboration and how can they be overcome?
- ❖ Do you track the participation and retention of minorities or other underrepresented groups in your department? If so, how successful have you been? Do you track the retention and success of transfer students?
- ❖ What kind of programs do you have (if any) to recruit students from other majors within your institution, from other institutions, and high school? What has been successful and what has not worked? Is this a priority for your department? What are the barriers to doing this? How can we raise the awareness of geosciences?
- ❖ What faculty interaction do you have locally between 2YCs, 4YCs and universities, Hispanic Serving Institutions (HSI), and Historically Black Colleges and Universities (HBCU's)? Are you part of a regional network? What successes or failures have you had with interactions, collaboration or regional networks? Is there a regional network your department could join or if not, would your department help one set up? What would motivate this? Benefits? Downsides?
- ❖ What proportion of students in 4YCs/universities are taking courses at 2YCs in the summer or while enrolled in 4YCs/universities? Are they taking geoscience, science/math or liberal arts courses? What would help these students be prepared for higher level courses and develop/learn the skills and concepts needed for undergraduate geoscience majors?

- ❖ Does your department help with preparation of middle and high school teachers by integrating the Next Generation Science Standards into your curriculum, have courses specifically designed for future teachers, or provide professional development programs courses or degree options for in-service teachers? Are there other ways your department helps with preparing future teachers? What can your department do to better prepare middle and high school teachers?