

CU's Dept of Geological Sciences – Science Education Initiative Project (GEOL-SEI): A five-year plan to introduce and support an evidence-based and scientific approach to teaching



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Science Education Initiative



The GEOL-SEI is a 5-year project.

Goals:

- Improve undergraduate geoscience education
- Change the basic approach to teaching and learning
- Adapt already demonstrated evidence-based productive teaching approaches
- Develop scientific approach to teaching through geoscience education research

Resources:

- ~\$1 million
- Administrative support
- Collaborators

On campus collaborators include other Dept-SEI projects and the SEI Central Staff.



Chemistry &
Biochemistry



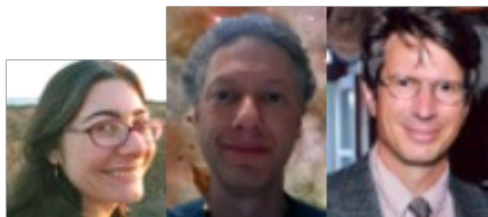
Geological Sciences



Integrative Physiology



Molecular, Cellular,
and Developmental
Biology

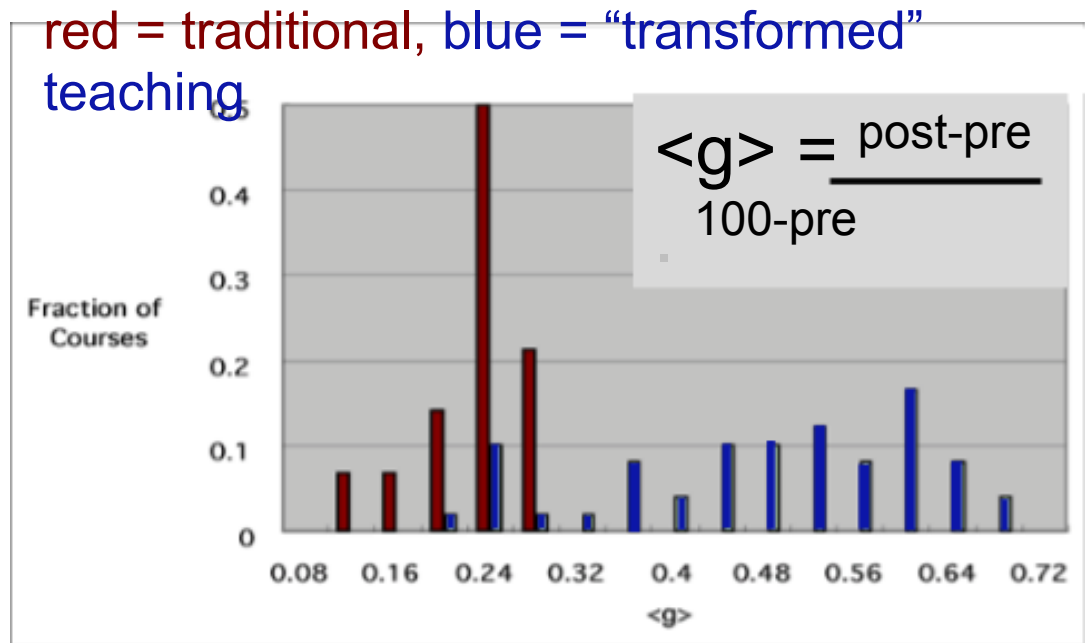


Physic
s

Central
Staff

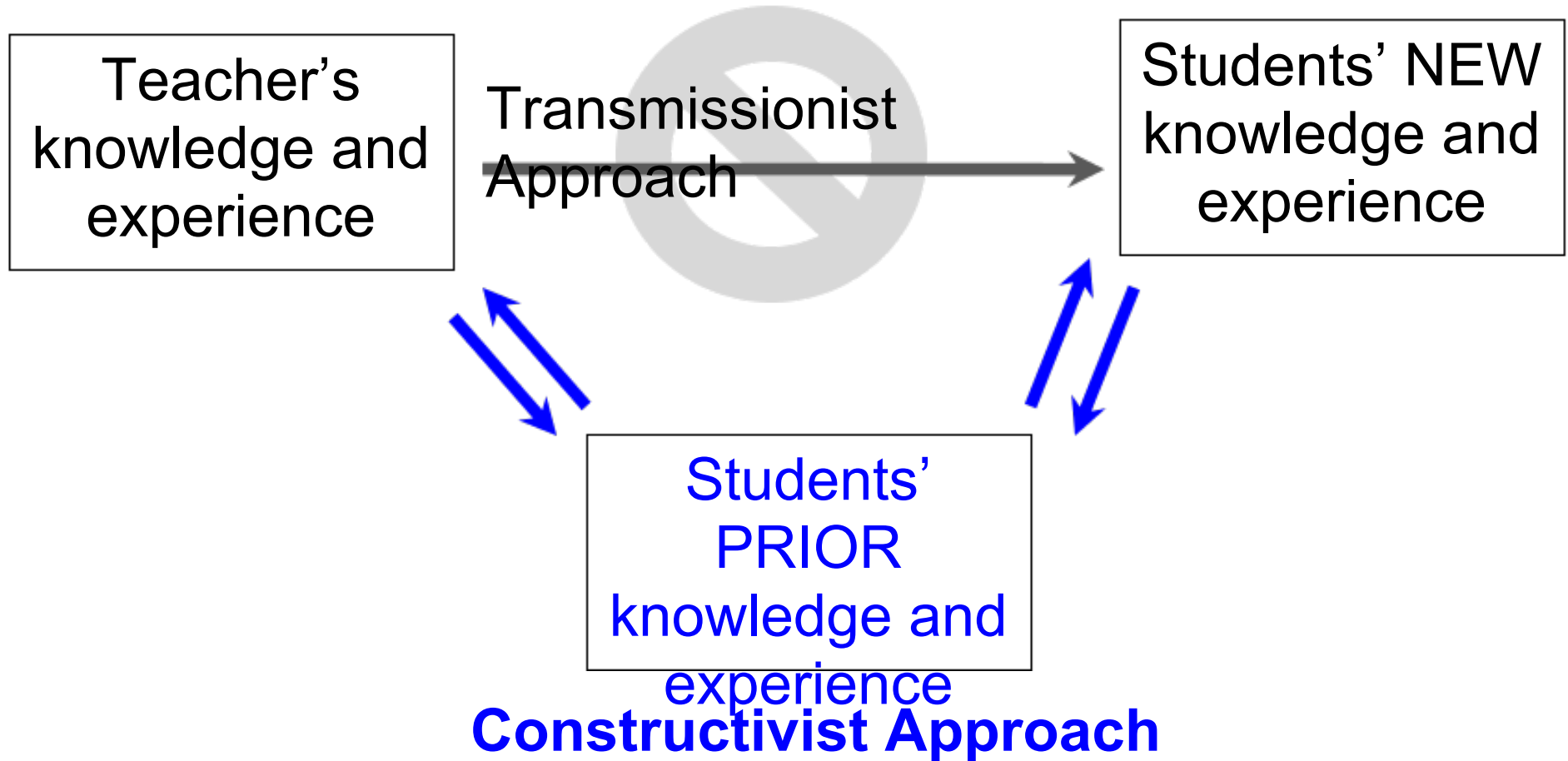


The GEOL-SEI operates with the understanding that the traditional approach to teaching is not optimal for deep learning (Hake 1998)

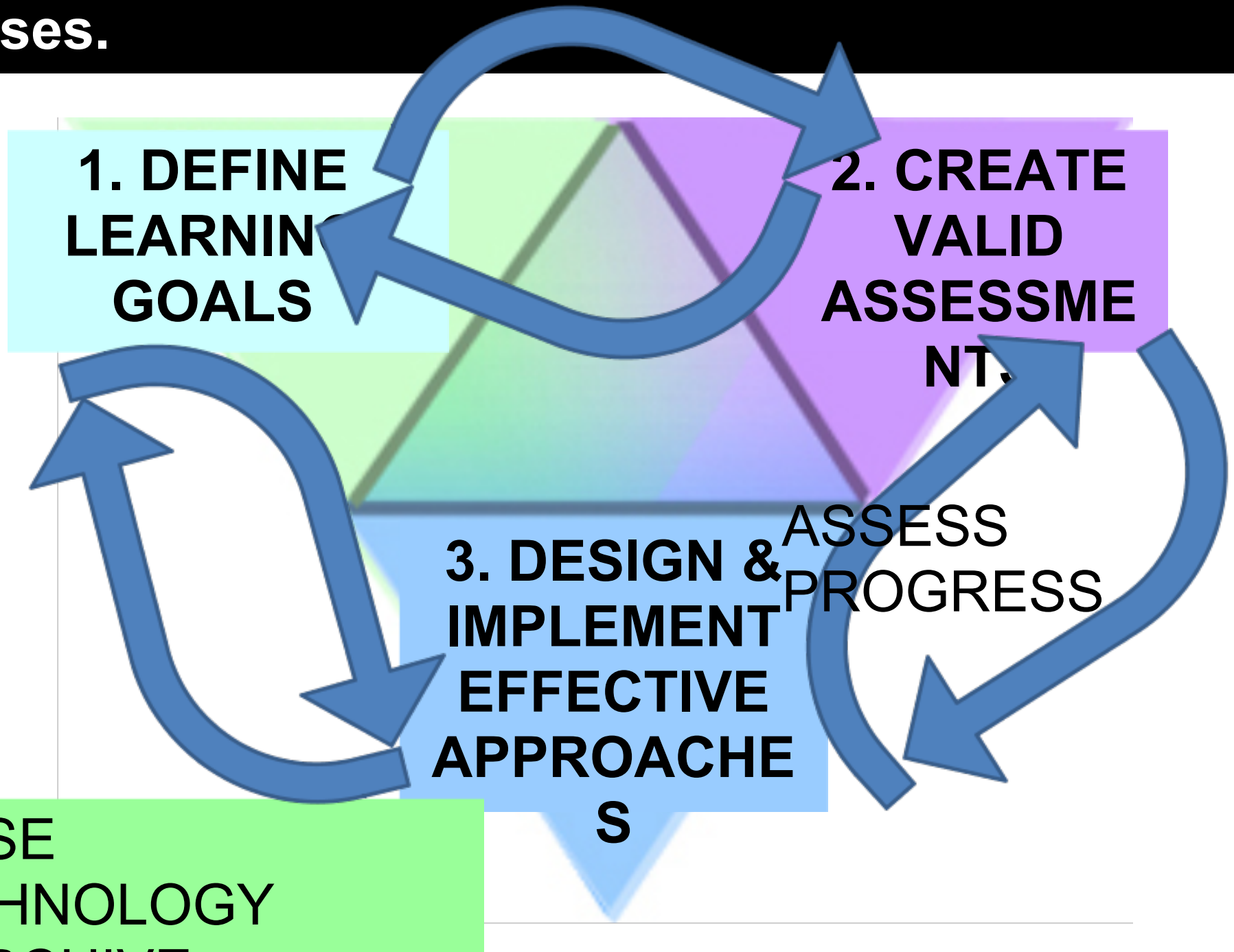


R. Hake, " ...A six-thousand-student survey..." AJP **66**, 64-74 ('98).

GEOL-SEI promotes and works with faculty to develop student-centered and interactive approaches to teaching and learning in their courses



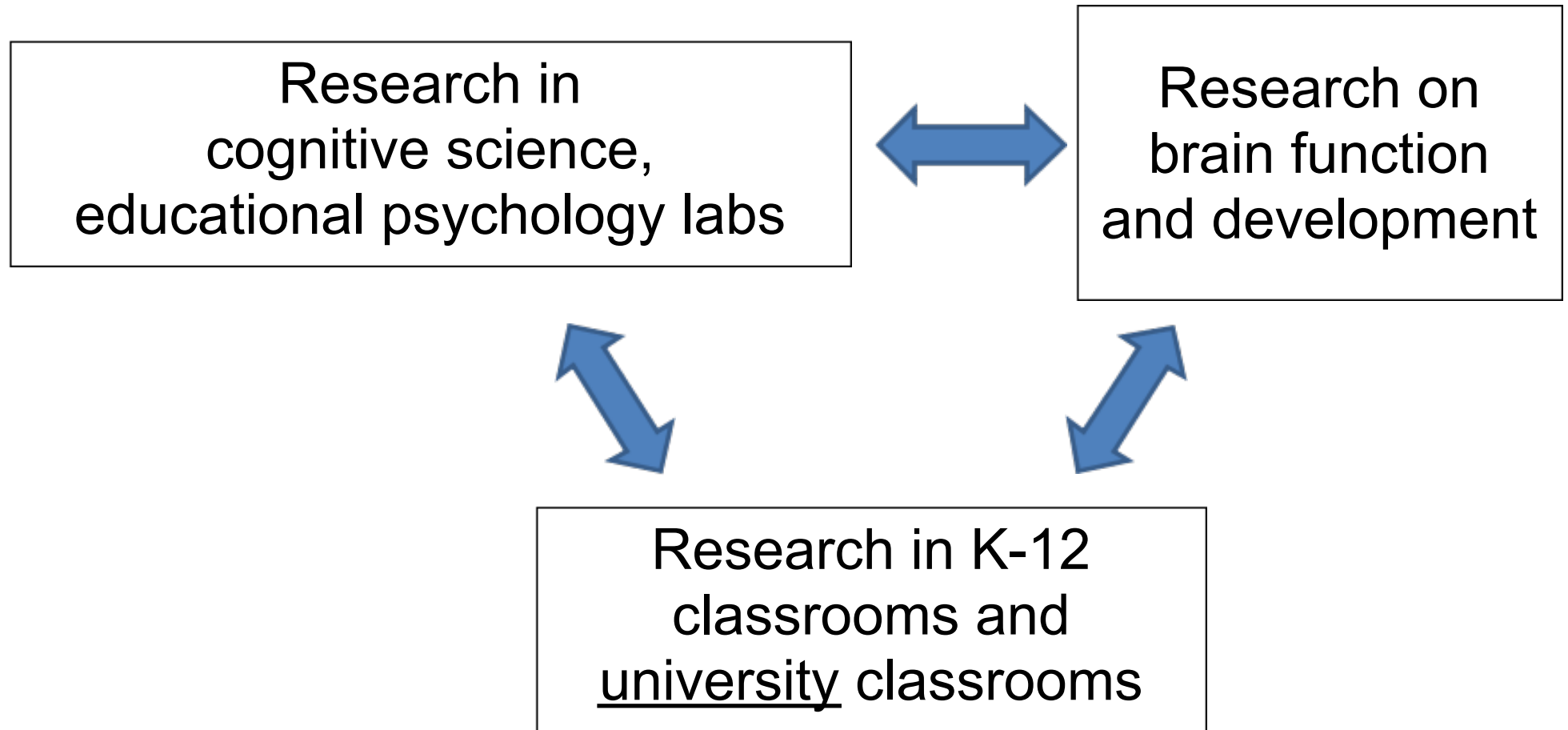
The GEOL-SEI uses a 3-step iterative process with instructors to transform existing and develop new courses.



The GEOL department began transforming their geoscience teaching in lower-division courses first.

Time Frame	Courses Taught by Geology Faculty
Fall 2006-present (inc. Springs)	GEOL 1010: Physical Geology
Fall 2006-present (inc. Springs)	GEOL 1020: Historical Geology
Fall 2007-present (inc. Springs)	GEOL 1030: Intro to Geology Lab I
Fall 2007, 2008, 2009	GEOL 2100: Environmental Geology
Fall 2007	ENVS 1000: Intro to Environmental St
Fall 2008 & 2009	GEOL 3010: Intro to Mineralogy
Fall 2008 & 2009	GEOL 3120: Structural Geology
Spring 2008 & 2009	GEOL 3070: Intro to Oceanography
Spring 2008 & 2009	GEOL 3430: Sedimentology & Stratigraphy
Spring 2009	GEOL 3520: Global Climate Change
Fall 2009	GEOL 3410: Paleobiology

To transform courses, GEOL-SEI uses and contributes to a growing body of STEM education research to inform best teaching practices at the undergraduate level



Transformed GEOL courses are characterized by learning goals, effective instructional approaches, and assessments.



Class discussion of student ideas



Conversion of "cookbook" style lab work to "innovative" lab work



Undergraduate peer facilitators



Peer-learning and group work

Types of assessments developed and used include:

- Challenging homework assignments
- Exams that promote sense-making over only answer-making
- Pre/post concept inventory surveys
- Pre/post attitudinal surveys

GEOL-SEI and faculty collaborations have resulted in gradual and positive transformations in the basic approach to teaching.

- ~66% faculty defined learning goals
- ~55% faculty changed their teaching practices to be more aligned with what research shows to be effective
 - E.g. assign regular HW assignments, facilitate in-class group activities, lead in-class discussion of conceptual questions (with or without clickers)
- ~38% faculty ask conceptual questions in class
- ~34% faculty use clickers to engage ALL students
- ~24% faculty use in-class group activities
- 10 undergraduate learning assistants were formally trained and assisted with teaching courses and labs
- 11 undergraduate courses have been impacted, which equates to ~10,960 students (between Fall 2006 and the present)

In addition to course and curriculum development, the GEOL-SEI also supports faculty and students by initiating and running other geoscience education-related activities:



GEOL graduate TA pedagogical training



GEOL undergraduate Learning Assistant program



Simulation development



GEOL Tutoring & Study program



iClicker faculty training and support

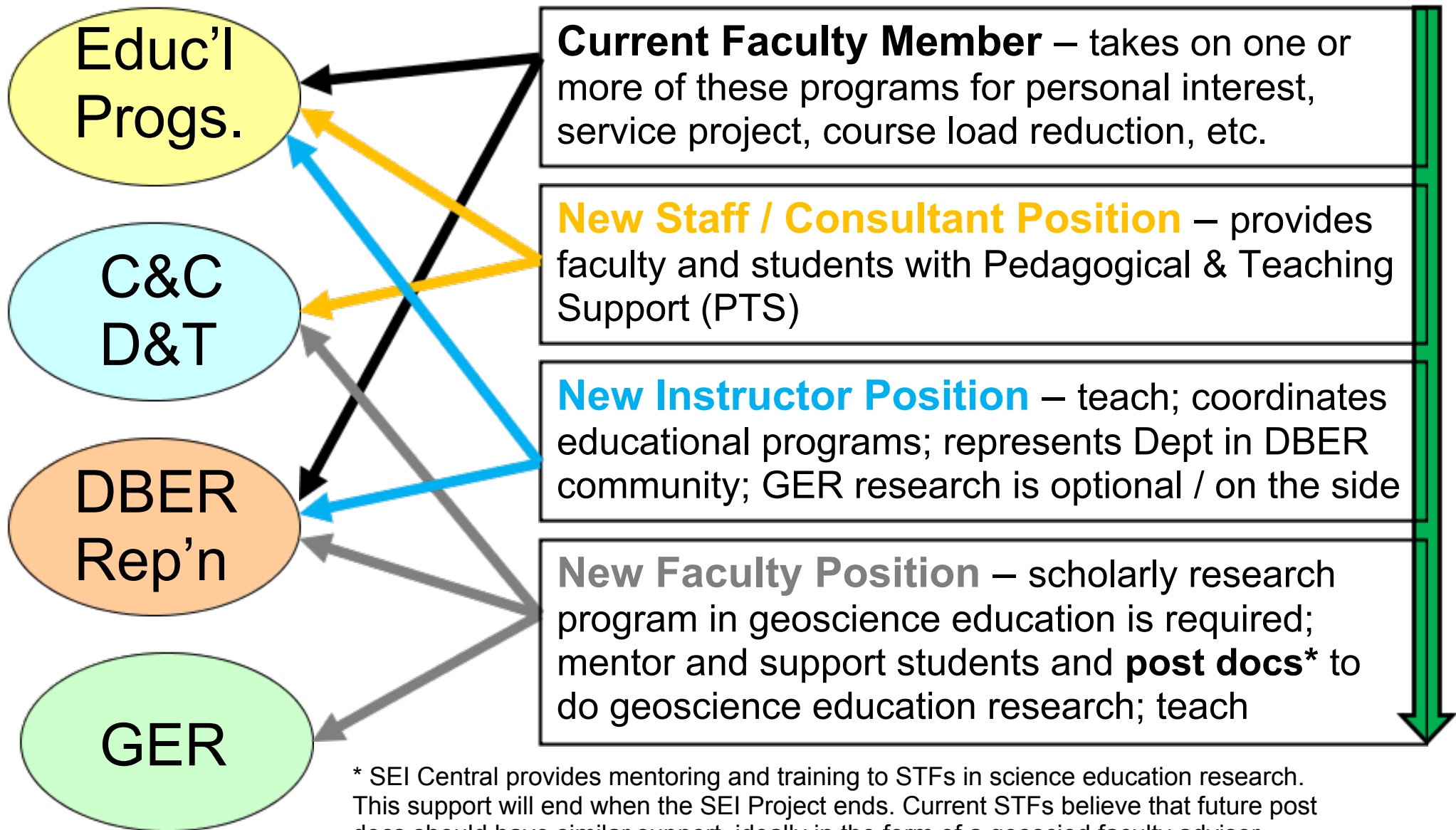


Monthly Geoscience Education faculty brown bag series

Efforts to integrate a scientific approach to teaching and learning has resulted in GEOL-SEI scholarship in Geoscience Education Research:

- Arthurs and Templeton, (in press), “Coupled collaborative in-class activities and individual follow-up homework promote interactive engagement and improve student learning outcomes in a college-level *Environmental Geology* course,” *Journal of Geoscience Education*
- Arthurs and Marchitto, (submitted), “A qualitative methods approach to developing an introductory oceanography concept inventory survey,” *GSA Special Papers: Qualitative Inquiry in Geoscience Education Research*
- Arthurs, (submitted), “What college-level students think: Student cognitive models of geoscience concepts, their alternate conceptions, and their learning difficulties,” *GSA Special Papers: Qualitative Inquiry in Geoscience Education Research*
- Bair, (submitted), “How ‘clicker’ technology affects students’ voting behavior and attitudes,” *Journal of Research in Science Education*
- Duncan and Arthurs, (submitted), “How do students respond to simple ways of improving student attitudes about science?” *Astronomy Education Review*
- Several other manuscripts are currently in preparation.

A model of sustainability might include one or more of the following possibilities.



* SEI Central provides mentoring and training to STFs in science education research. This support will end when the SEI Project ends. Current STFs believe that future post docs should have similar support, ideally in the form of a geoscied faculty advisor.

Thank you!

Any questions?

