METROPOLITAN STATE UNIVERSITY OF DENVER

25-28 SEPTEMBER
GSA 2016
Denver, Colorado, USA

**Session 187**

***Tuesday, 27 September 2016: 8:00 AM-12:00 PM***

# SUCCESS AS A SMALLER FISH IN A BIG POND: A HOLISTIC APPROACH TO UNDERGRADUATE GEOLOGIC EDUCATION AS A COMPETITIVE ADVANTAGE FOR SECURING POST-BACCALAUREATE OPPORTUNITIES

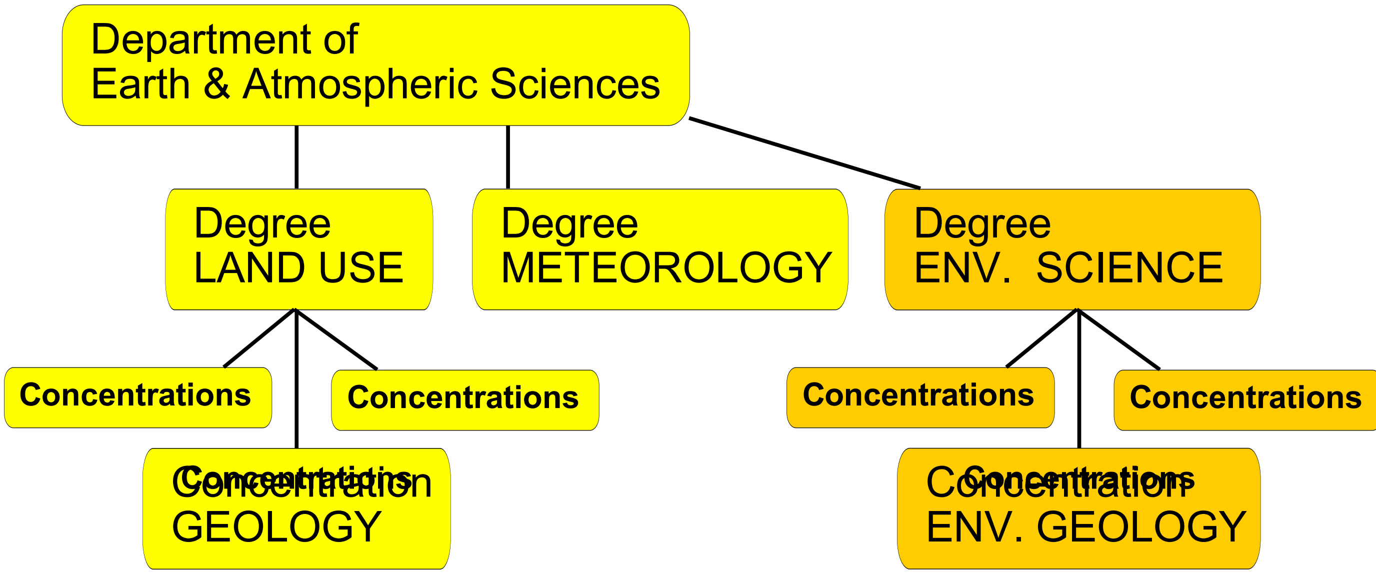
Uwe Kackstaetter, Ph.D.[1]
*Presenter*

Barbara EchoHawk, Ph.D.[1]

[1] ***Metropolitan State University of Denver***

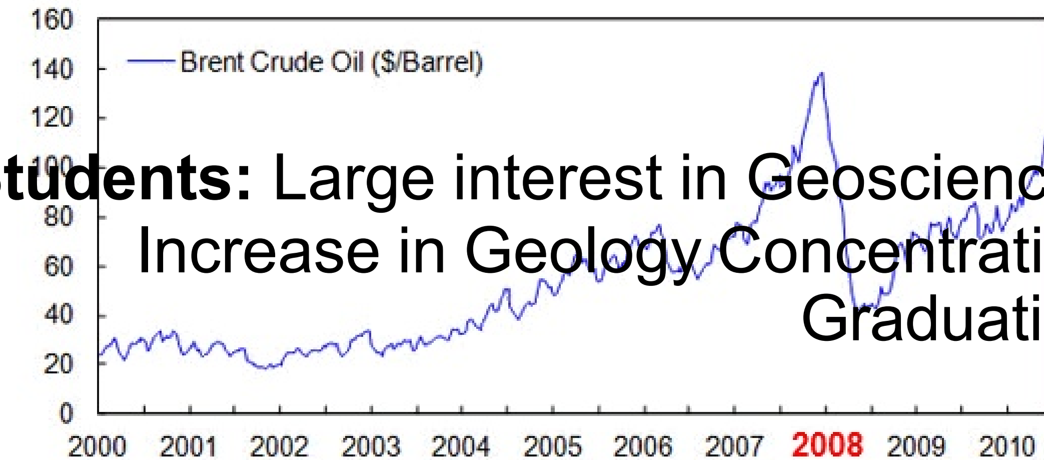
# Background

Geology at Metropolitan State *College* of Denver

# The Change

Metropolitan State University of Denver



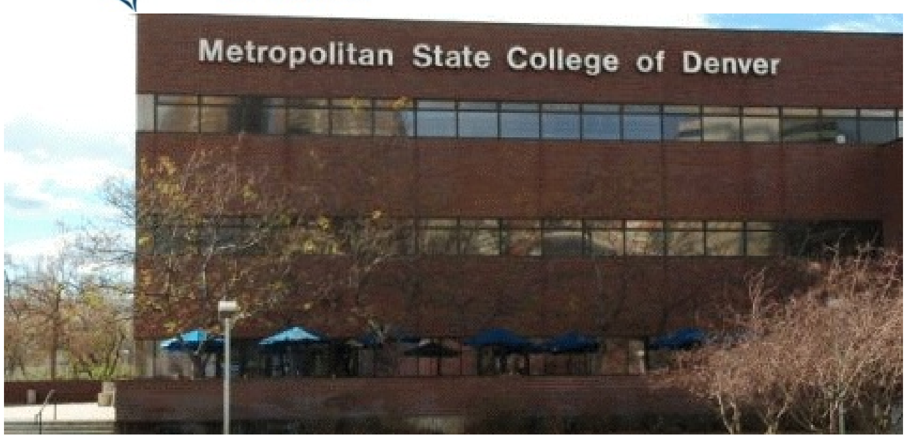

**Students:** Large interest in Geosciences

Increase in Geology Concentration

Graduation

"New Degrees"

**"No duplication of degrees"**




Stand-Alone Geology Degree that does NOT duplicate traditional Geology Degrees offered elsewhere?

# The Study

## Developing the Concept

**Geoscience Graduate Profile**

~30% Graduate School
~70% Workforce

Focus

Next to academically sound proficiency ... workforce readiness?

**Available Resources**

1. Faculty Expertise
   *International, Field, Equipment, Industry, etc.*
2. Courses
   *Established Field Courses, International Courses, Internships*
3. Equipment
   USED
   *Thin Section Lab, PLM, XRD, SEM, etc.*

# The Study

## Developing the Concept


**Peter D. Hart Research Associates. 2013.** *It Takes More Than A Major: Employer Priorities for College Learning and Student Success*, An Online Survey Among Employers Conducted On Behalf Of: The Association Of American Colleges And Universities By Hart Research Associates

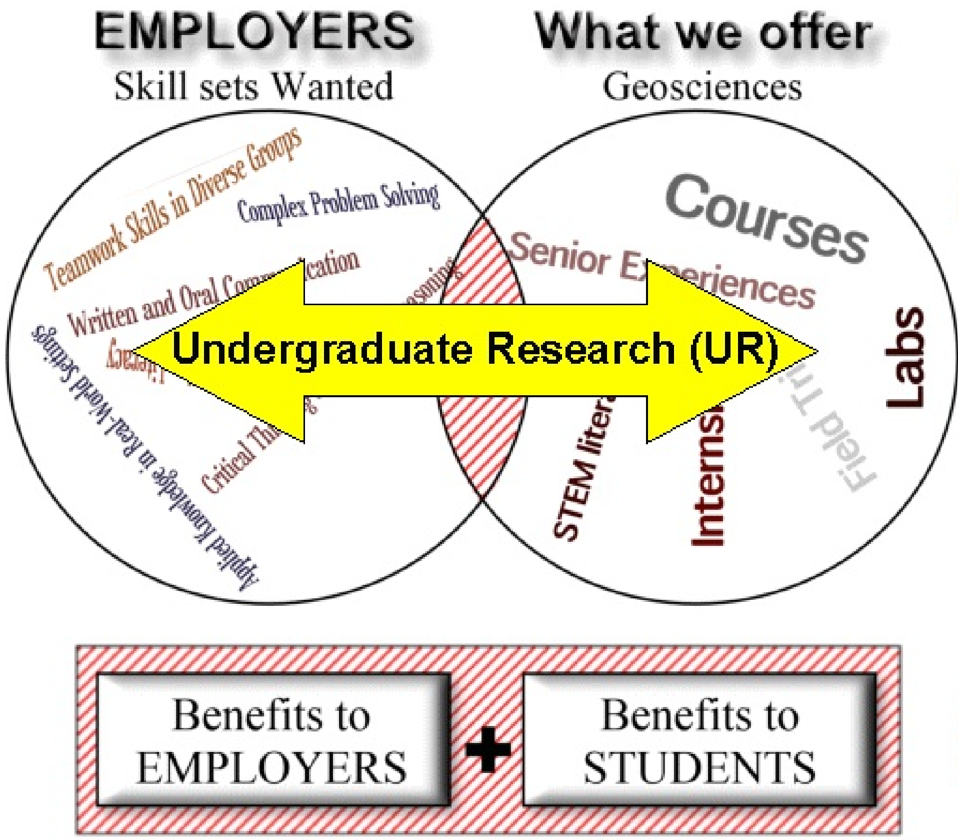
# The Study

## Developing the Concept

# The Study

## Developing the Concept

Traditional




UR Focused Approach

# The Study

**EMPLOYERS**
Skill sets Wanted

**What we offer**
Geosciences


Benefits to EMPLOYERS + Benefits to STUDENTS

UNDERGRADUATE RESEARCH
*Our Niche?*

1. NOT popular
   *Time consuming; NO real compensation; NO real publishable results;* Limited pub outlets ?
2. Limited Resource Friendly
   *NO large research expenditures; Simplified Grading; Private Partnership Opportunities (European Model)*

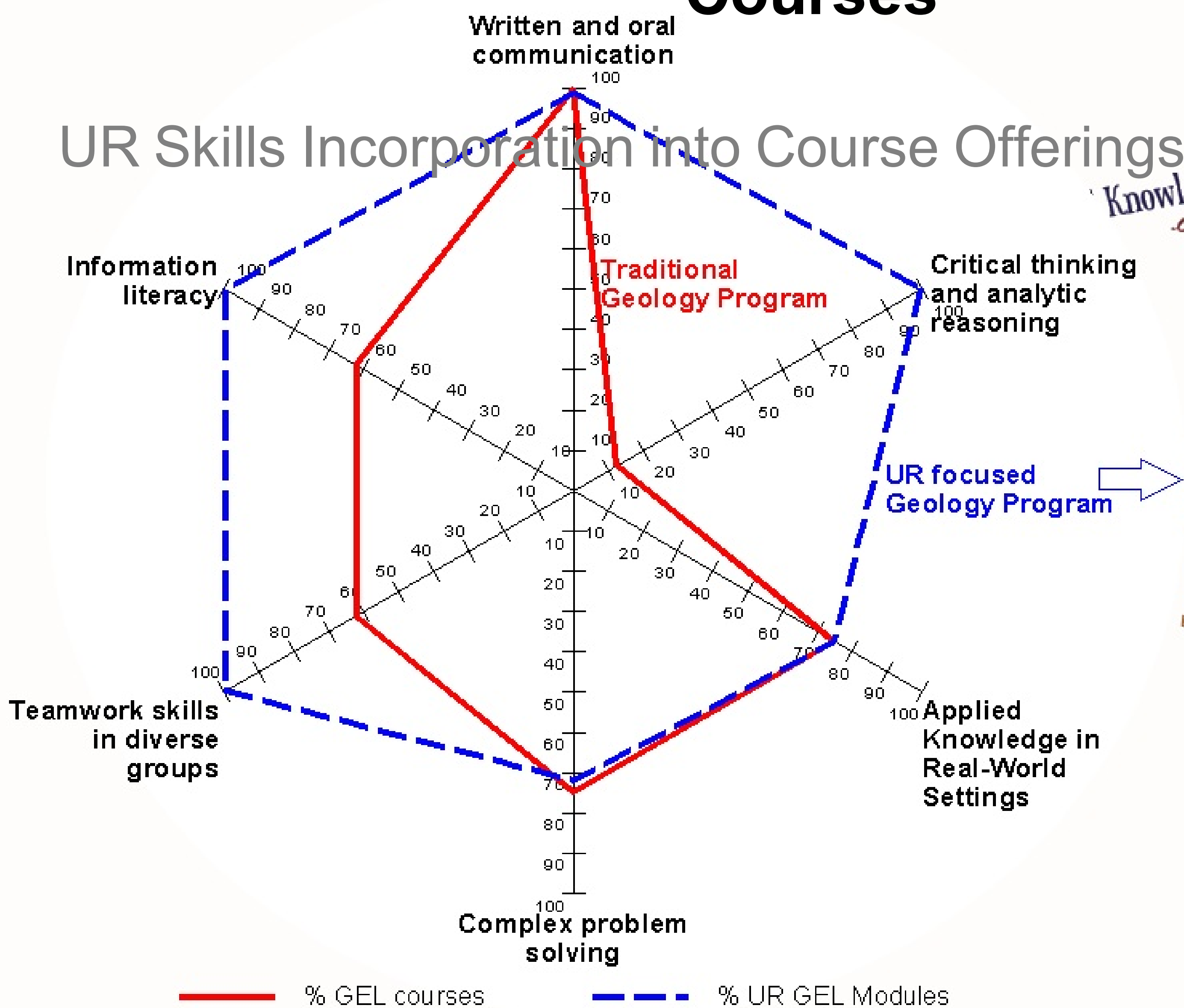
# Courses

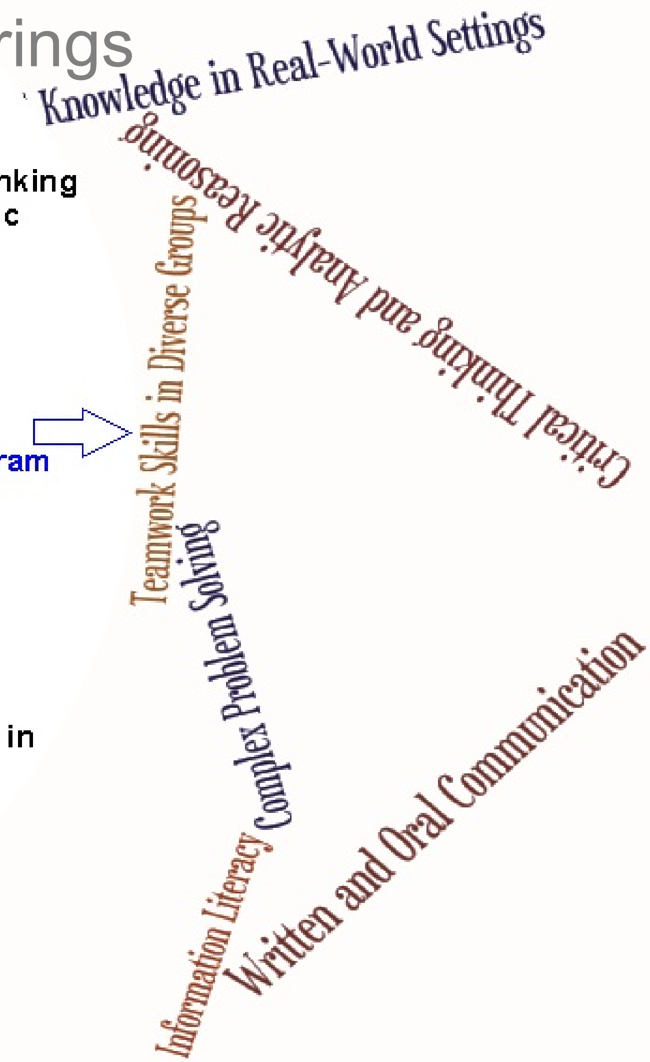
UR Skills Incorporation into Course Offerings

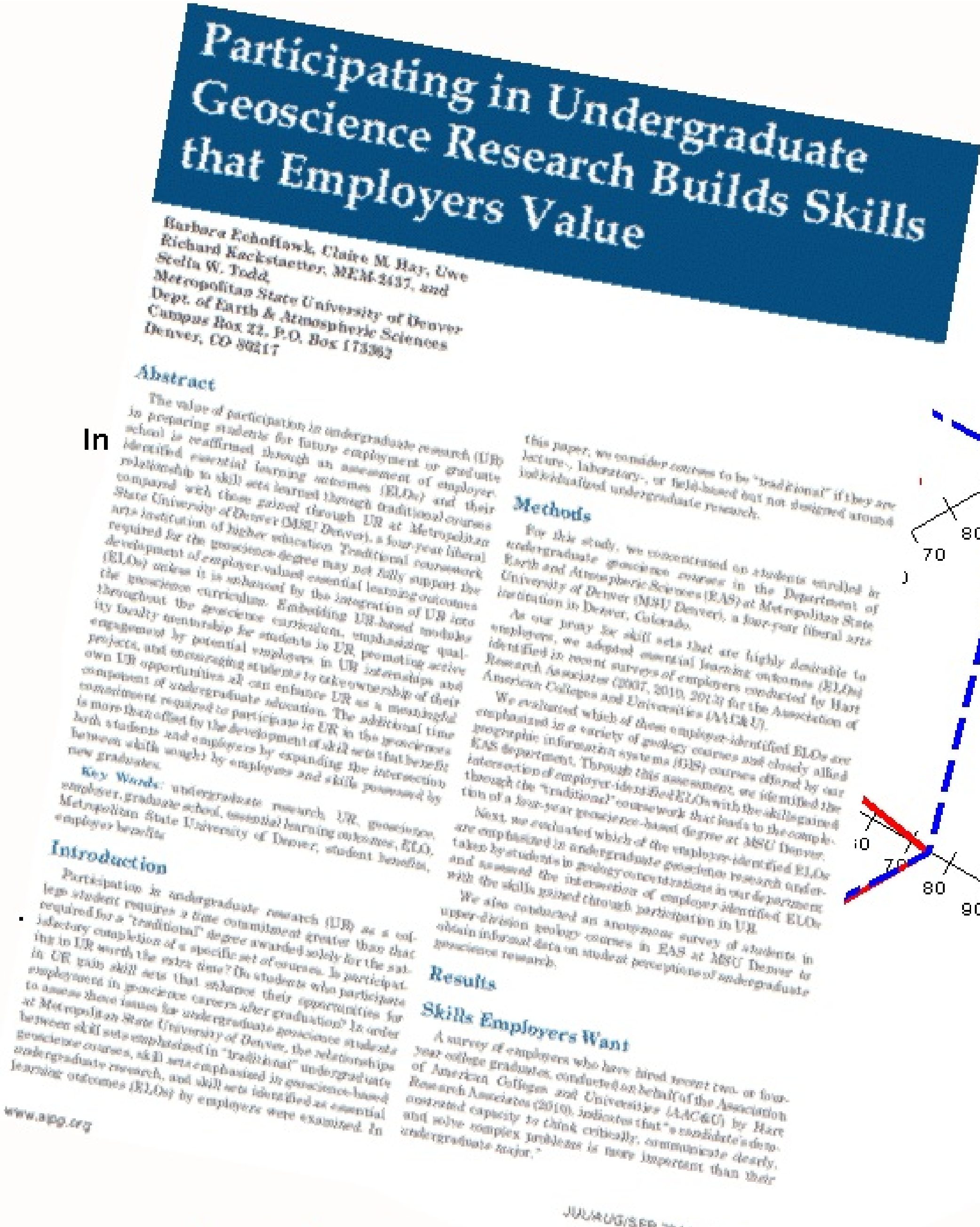
- **No NEW Course Resources**
  - Incorporate Work Force Readiness / UR skills into existing coursework
  - Make **Assignments RELEVANT** to real skills without compromising foundational content

# Courses

UR Skills Incorporation into Course Offerings





# Participating in Undergraduate Geoscience Research Builds Skills that Employers Value

Barbara EchoHawk, Claire M. Hay, Uwe Richard Kackstaetter, MEM-2437, and Stella W. Todd,
Metropolitan State University of Denver
Dept. of Earth & Atmospheric Sciences
Campus Box 22, P.O. Box 173362
Denver, CO 80217

**Abstract**

The value of participation in undergraduate research (UR) in preparing students for future employment or graduate school is reaffirmed through an assessment of employer-identified essential learning outcomes (ELOs) and their relationship to skill sets learned through traditional courses compared with those gained through UR at Metropolitan State University of Denver (MSU Denver), a four-year liberal arts institution of higher education. Traditional coursework required for the geoscience degree may not fully support the development of employer-valued essential learning outcomes (ELOs) unless it is enhanced by the integration of UR into the geoscience curriculum. Embedding UR-based modules throughout the geoscience curriculum, emphasizing quality faculty mentorship for students in UR, promoting active engagement by potential employers in UR internships and projects, and encouraging students to take ownership of their own UR opportunities all can enhance UR as a meaningful component of undergraduate education. The additional time commitment required to participate in UR in the geosciences is more than offset by the development of skill sets that benefit both students and employers by expanding the intersection between skills sought by employers and skills possessed by new graduates.

**Key Words**: undergraduate research, UR, geoscience, employer, graduate school, essential learning outcomes, ELO, Metropolitan State University of Denver, student benefits, employer benefits

## Introduction

Participation in undergraduate research (UR) as a college student requires a time commitment greater than that required for a "traditional" degree awarded solely for the satisfactory completion of a specific set of courses. Is participating in UR worth the extra time? Do students who participate in UR gain skill sets that enhance their opportunities for employment in geoscience careers after graduation? In order to assess these issues for undergraduate geoscience students at Metropolitan State University of Denver, the relationships between skill sets emphasized in "traditional" undergraduate geoscience courses, skill sets emphasized in geoscience-based undergraduate research, and skill sets identified as essential learning outcomes (ELOs) by employers were examined. In this paper, we consider courses to be "traditional" if they are lecture-, laboratory-, or field-based but not designed around individualized undergraduate research.

## Methods

For this study, we concentrated on students enrolled in undergraduate geoscience courses in the Department of Earth and Atmospheric Sciences (EAS) at Metropolitan State University of Denver (MSU Denver), a four-year liberal arts institution in Denver, Colorado.

As our proxy for skill sets that are highly desirable to employers, we adopted essential learning outcomes (ELOs) identified in recent surveys of employers conducted by Hart Research Associates (2007, 2010, 2013) for the Association of American Colleges and Universities (AAC&U).

We evaluated which of these employer-identified ELOs are emphasized in a variety of geology courses and closely allied geographic information systems (GIS) courses offered by our EAS department. Through this assessment, we identified the intersection of employer-identified ELOs with the skills gained through the "traditional" coursework that leads to the completion of a four-year geoscience-based degree at MSU Denver.

Next, we evaluated which of the employer-identified ELOs are emphasized in undergraduate geoscience research undertaken by students in geology concentrations in our department and assessed the intersection of employer-identified ELOs with the skills gained through participation in UR.

We also conducted an anonymous survey of students in upper-division geology courses in EAS at MSU Denver to obtain informal data on student perceptions of undergraduate geoscience research.

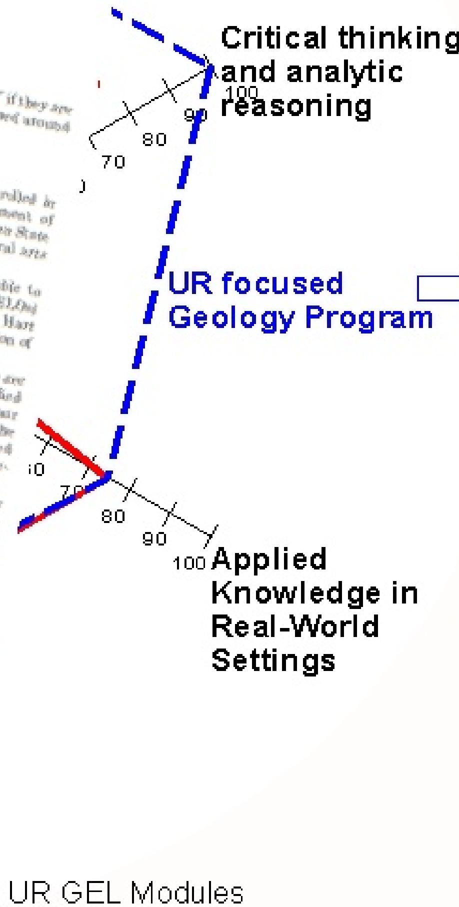
## Results

### Skills Employers Want

A survey of employers who have hired recent two- or four-year college graduates, conducted on behalf of the Association of American Colleges and Universities (AAC&U) by Hart Research Associates (2010), indicates that "a candidate's demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than their undergraduate major."



In




# EXAMPLES

## GEL3050 MINERALOGY & OPTICAL MINERALOGY

- Skill Sets:
  - Thin Sections & PLM
  - Rapid Mineral ID Procedure
- PROJECT:

- Real Clients
- Instrumentation:
  Portable XRF, Scintag XRD, PLM


**MINERALOGY PROFESSIONAL MINERAL ID PROJECT (250 pts)**

This course offers free non-destructive & certain destructive mineral identification services to outside clients, community and industry. You will be assigned a client sample to provide analytical services on the unknown mineral . In the end you will be required to present the client(s) with a full analytical report. Your work must meet a minimum standard of quality and professionalism.

# EXAMPLES



## GEL4250 HYDROGEOLOGY (Groundwater)

**Successful job search credited to this project alone reported by alumni**

- Skill Sets:
  - Data Analysis
  - Result Application
- PROJECT:

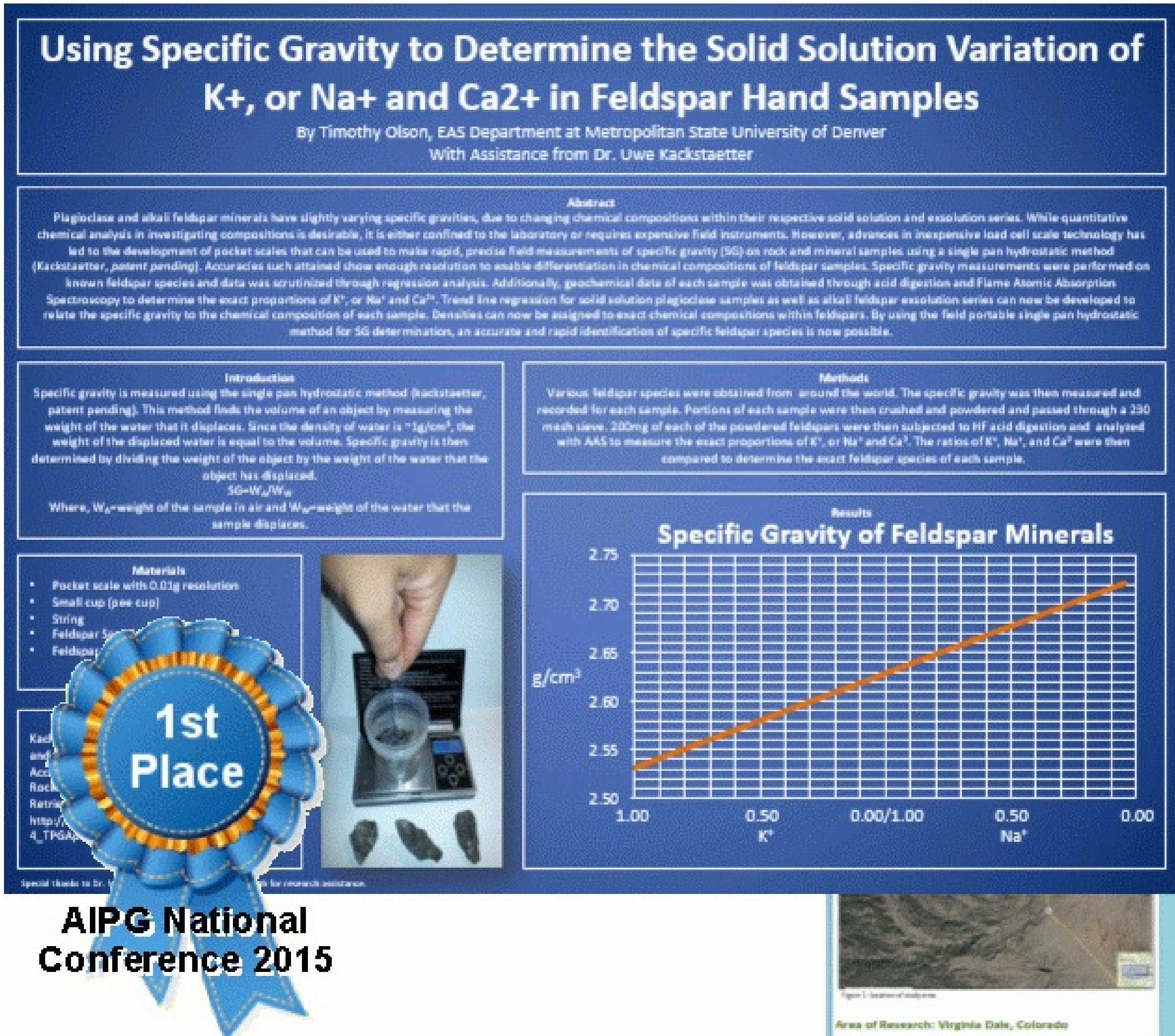
GEL4250 Groundwater (Hydrogeology) Page 1
Percolation Test Project

**YOUR ASSIGNMENT**

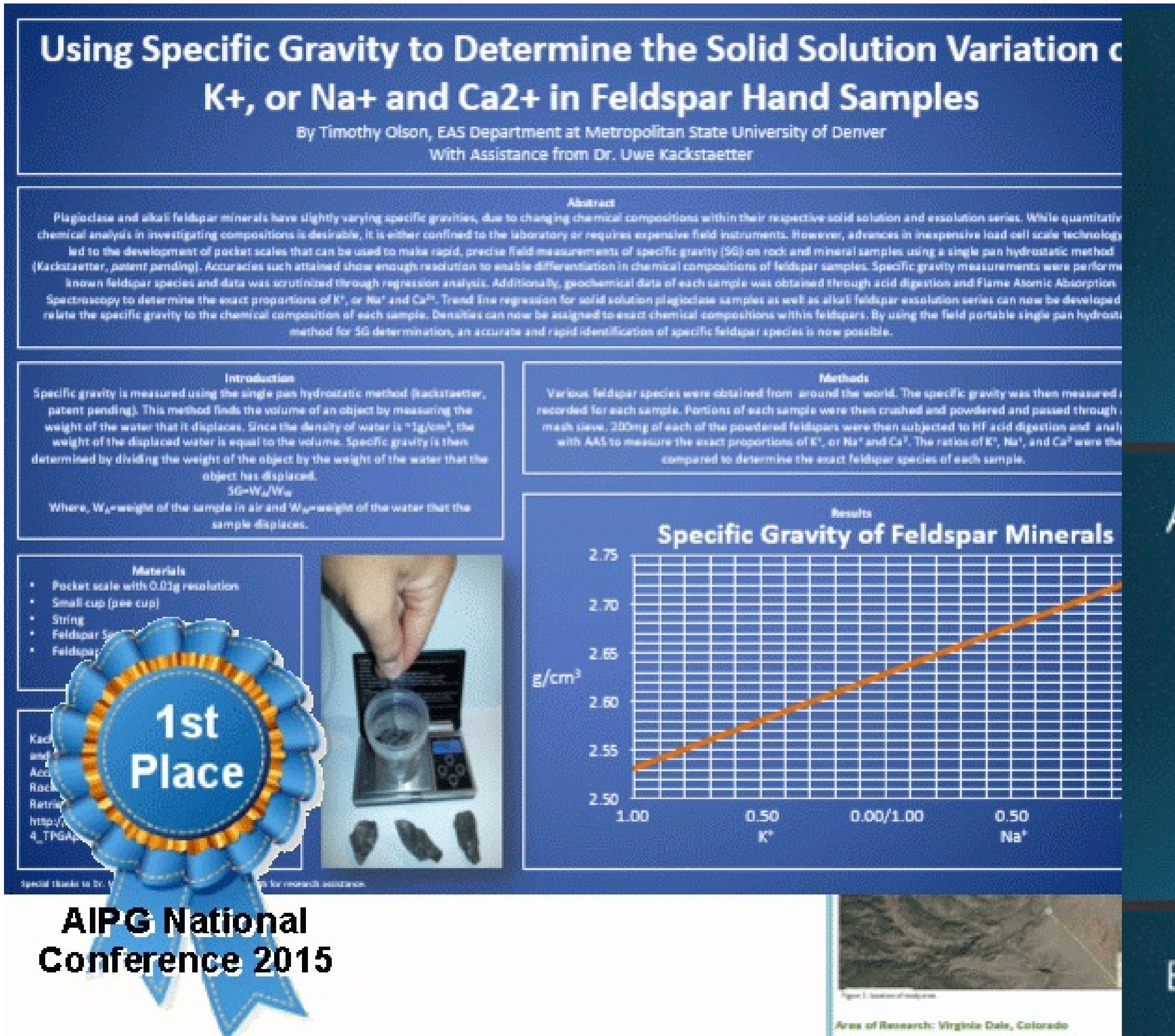
- ☐ You may work in groups. Selected a suitable field site (someone's property) to dig percolation test holes and do the field study and measurements.
- ☐ Do the perc test. Record all data. You may share the results among your group.
- ☐ Do the computations and generate the professional report. This part must be uniquely yours. NO group work allowed!
- ☐ Turn in the report by the deadline(s) indicated for grading.

# EXAMPLES

## Undergraduate Research Projects


Using Specific Gravity to Determine the Solid Solution Variation of K+, or Na+ and Ca2+ in Feldspar Hand Samples
By Timothy Olson, EAS Department at Metropolitan State University of Denver
With Assistance from Dr. Uwe Kackstaetter
Abstract
Plagioclase and alkali feldspar minerals have slightly varying specific gravities, due to changing chemical compositions within their respective solid solution and exsolution series. While quantitative chemical analysis in investigating compositions is desirable, it is either confined to the laboratory or requires expensive field instruments. However, advances in inexpensive load cell scale technology has led to the development of pocket scales that can be used to make rapid, precise field measurements of specific gravity (SG) on rock and mineral samples using a single pan hydrostatic method (Kackstaetter, patent pending). Accuracies such attained show enough resolution to enable differentiation in chemical compositions of feldspar samples. Specific gravity measurements were performed on known feldspar species and data was scrutinized through regression analysis. Additionally, geochemical data of each sample was obtained through acid digestion and Flame Atomic Absorption Spectroscopy to determine the exact proportions of K+, or Na+ and Ca2+. Trend line regression for solid solution plagioclase samples as well as alkali feldspar exsolution series can now be developed to relate the specific gravity to the chemical composition of each sample. Densities can now be assigned to exact chemical compositions within feldspars. By using the field portable single pan hydrostatic method for SG determination, an accurate and rapid identification of specific feldspar species is now possible.
Introduction
Specific gravity is measured using the single pan hydrostatic method (Kackstaetter, patent pending). This method finds the volume of an object by measuring the weight of the water that it displaces. Since the density of water is ~1g/cm3, the weight of the displaced water is equal to the volume. Specific gravity is then determined by dividing the weight of the object by the weight of the water that the object has displaced.
SG=WA/WW
Where, WA=weight of the sample in air and WW=weight of the water that the sample displaces.
Methods
Various feldspar species were obtained from around the world. The specific gravity was then measured and recorded for each sample. Portions of each sample were then crushed and powdered and passed through a 230 mesh sieve. 200mg of each of the powdered feldspars were then subjected to HF acid digestion and analyzed with AAS to measure the exact proportions of K+, or Na+ and Ca2. The ratios of K+, Na+, and Ca2 were then compared to determine the exact feldspar species of each sample.
Materials
Pocket scale with 0.01g resolution
Small cup (pee cup)
String
Results
Specific Gravity of Feldspar Minerals
g/cm3
2.75
2.70
2.65
2.60
2.55
2.50
1.00
0.50
0.00/1.00
0.50
0.00
K+
Na+
1st Place
AIPG National Conference 2015


w Suspected Kimberlite
Northern Colorado
hanie Gallegos and Uwe Kackstaetter, Ph.D.
Undergraduate Research
METROPOLITAN STATE UNIVERSITY OF DENVER
Methodology
Identification of Kimberlites
Kimberlite Indicator Minerals (KIMs)
Area of Research: Virginia Dale, Colorado
Results and Conclusions
Results
Conclusion
References
1st Place
AIPG National Conference 2013




AIPG National Conference 2015



GSA 2014 Presentation


The origin of a layer of subcircular mudflakes in the Ross Sandstone Formation of County Clare, Ireland
OF HEAVY METAL
PTION BY PLANTS
R MEDIEVAL-AGED
DUMP MATERIALS
that graze on a hillsides with
ick, whereas, the other side of the
grazing grounds
aste rocks are around the longer
heavy metals into the
GSA 2014
Presentation
Erzgebirge, Germany
AGU 2015
Poster
Presentation
Conference 2015
Area of Research: Virginia Dale, Colorado

## Development Incorporating our Findings

"No duplication of degrees"

## Title: APPLIED GEOLOGY MAJOR (B.S.)

**Program Goals**

1. To build student's knowledge base in geoscientific concepts, principles and processes;
2. To prepare and train students in field and laboratory technologies and techniques used in geoscientific investigation and interpretation; Skills with a purpose!!!
3. To develop competency in written and oral scientific communication and presentation; Not only research papers!!!
4. To construct habits of critical thinking and creative problem solving that lead to informed decision making, life-long learning, and leadership based on current scientific knowledge; and
5. To prepare students for successful entry into career or graduate programs .

METROPOLITAN STATE UNIVERSITY OF DENVER

# Geology Program

25-28 SEPTEMBER GSA 2016 Denver, Colorado, USA

## Development Incorporating our Findings

# Title: APPLIED GEOLOGY MAJOR (B.S.)

| Applied Geology Major Required Core Courses | | | Prerequisites |
|---|---|---|---|
| GEL | 1010 | Physical Geology | Pre-assessme |
| GEL | 1030 | Historical Geology | |
| GEL | 2530 | Introduction to Field Methods **10 days in the field** | |
| GEL | 3050 | Intro to Mineralogy and Optical Mineralogy | GEL 1010 & ( |
| GEL | 4450 | Sedimentary Geology and Stratigraphy | GEL 1010, GE<br>MTH 1120 or |
| GEL | 4460 | Structural Geology and Mapping | GEL 4450 |
| GEL | 3120 | Geomorphology | GEL 1010 or |
| GEL | 3530 | Adv. Geology of the Colorado Plateau ← | ~~9 hours of GE~~ |
| GIS | 1220 | Introduction to Geospatial Sciences | CSS 1010 or ( |
| GIS | 2250 | Geographic Information Systems | GIS 1220 |
| *Applied Geology Core Credits* | | | |

| Applied Geology Degree Totals | |
|---|---|
| General Studies (includes the Global Diversity and Multicultural Requirement) | |
| Applied Geology Degree Required Core Courses | |
| Mathematics Electives beyond Algebra | |
| CHE and PHY Electives beyond General Chemistry and College Physics | |
| Applied Geology Degree Electives 11 with GEL prefix | |
| Internship | |
| Senior Experience GEL 4970 Undergraduate Research in Geology | 4 |
| Unrestricted Electives* | 17 |
| *Applied Geology Total Credits* | *120* |

*Students must have 40-hours of upper division course work (3000 & 4000 level)

## GEL Field Course Offerings

*National & International*

*Samples:*

### Applied Volcanology

**3,400 miles:** Incl. Yellowstone, Craters of the Moon, Mt. Rainier, Mt. St. Helens, Crater Lake, Lassen Volcanic Park, and more!

***Variable Topics*** **10 days in the field** **10 days**

**Can be taken up to 4 times; 4 different destinations**

### Burren Geologic Field School

***Caherconnell, Ireland*** **2 weeks**

**In conjunction with NUIG (National University of Ireland - Galway)**

### Structural Geology & Mineralogy of the Alps

***Germany, Austria, Italy, Switzerland***

**2 weeks**

# Q&A

Questions, Comments,...