Power of Undergraduate Research:
Mentoring non-science majors with experiential learning experience

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Mentor:
an experienced and trusted person who gives another person advice and help, esp. related to work or school, over a period of time
https://www.merriam-webster.com/dictionary/mentor

Experiential learning:
Students would “learn by doing,” applying knowledge to experience in order to develop skills or new ways of thinking
The role of the instructor is a guide, a cheerleader, a resource, and a support.
How can a mentor support experiential learning?

The mentor should:

- identify certain groups of students that have the most to gain from experiential learning→ inclusive early research

- help the mentee(s) identify and provide the experiential learning opportunities that will engage the mentee in critical development.

- review the mentee’s development progress, confirming that the experiential learning is working.
Classroom-based experiential learning: integrating research experience into course assignments

- Teaching through conversation
- Real-life application
- Context

Stella and Charles Guttman Community College | guttman.cuny.edu
Classroom-based experiential learning for non-science majors (CHEM 110)

- Integrating research experience into the curriculum; lecture-lab integration; increasing accessibility,
- Facilitating inquiry-based class activities: (1) focusing on discovery, collaboration, and scientific practices, (2) making the science relevant

  e.g. fieldtrip: Newtown Creek Wastewater treatment facility research project: Biofuel production
How experience plays a role in learning process?

- Work in a group, self management
- research the benefits of using biofuel over petroleum-based diesel: learn chemistry in a cultural and broader social context
- collect waste cooking oil from home or restaurants: learn scientific international units and collaborate with the community
- develop simple and cost-effective methods to produce Biodiesel: self-discovery process, understanding chemical reactions involved
- Reflect on their new knowledge
Waste cooking oil from street vendors

“my family uses cooking spray and produces 12-15 oz of oil per week.”

“I visited street vendors and asked for waste cooking oil.”
Group Presentation
Group Presentation
Assessments

- **Pre-project**: Self-assessment of their knowledge, skills and attitudes
- **During the process**: Presentation (peer-reviewed), quiz, lab/data sheet
- **Post-project**: Self-assessment of their knowledge, skills and attitudes, quiz, complete reports based on Science Writing Heuristics (reflective writing)
Impact and effectiveness: students in CHEM 110 say

Before Biofuel project
• Chemistry is abstract
• Math-intensive
• Chemistry demands lots of memorization
• Chemistry is irrelevant and boring

At present
• still working on the project (3-week long project), appreciate the real-life application
• Chemistry is part of our lives
• I learn better and never forgot what I learned
• **Early Research**: undergraduate research, mentored, self-directed work, encouraging minority students to take part in *STEM-related majors*

• Kizzy’s abstract (oral presentation) has been accepted in the program for the 66th Annual Undergraduate Research Symposium (URS)-New York American Chemical Society (ACS), May 5th 2018, Queens, NY
My research at Stella and Charles Guttman community college has started in October 2017 (library research) and hands-on research in January 2018. This was also the time when I was introduced into Chemistry. I had always wanted to take all sciences courses, but because my High school did not offer some courses, I did not have the opportunity to take them. When I started with my chemistry research, I was happy because it means to me to learn something new, and I had always felt passionate about new learning.
THE EFFECT OF MOLECULAR SIEVES IN BIODIESEL PRODUCTION.

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Biofuel

- Alternative fuel for diesel engines
- Made from Vegetable oil or animal fat
- Renewable
- Biodegradable, and non-toxic

Http://www.slideshare.net/saurabhkumarverma19/biofuel-33608124
Reported Studies: Raw oil sources of Biodiesel

Palm oil
Rape seed oil,
Soyabean oil,
Sunflower oil,
Canola oil,
Coconut oil,
Jatropha nut oil,
Used Cooking Oil,
Animal fats

Conversion

Bio-Diesel

Http://www.macquarieoils.com/
Advantages Vs. Disadvantages Of Biofuel usage

**Advantages:**

1. Cost Benefit
2. Easy To Source
3. Renewable
4. Reduce Greenhouse Gases
5. Shortage of Food
6. Economic Security
7. Reduce Dependence on Foreign Oil
8. Lower Levels of Pollution

**Disadvantages:**

1. High Cost of Production
2. Monoculture:
3. Use of Fertilizers
4. Industrial Pollution
5. Water Use
6. Future Rise in Price

Catalysts used in the Biodiesel production:

- NaOH
- KOH
- CaO
- KOH/Al₂O₃
- Concentrate sulfuric acid
- ZnO/I₂
- Enzymes
- NaOH and 3A MS → our co-catalyst system
Goals

• Investigate environmental friendly, reusable heterogeneous catalyst: MS

• Find optimal reaction conditions

• Prevent a by-product, soap, during process
Molecular Sieves:

• Molecular sieves are small materials that contain small pores such as carbon and porous glass.

• They contain rigid crystalline aluminosilicates with high adsorption capacities, such as water or small molecules.

• Strong base

→ Employ MS and NaOH as co-catalyst, water scavenger and base catalyst

http://hengyeusa.com/community/molecular-sieve-pore-sizes
Materials

- Molecular sieves 3 Å
- Methanol / Ethanol (absolute)
- NaOH
- Cooking oil (soybean)
- Waste cooking oil (collected from my kitchen, Harlem, NY)

Note: Waste cooking oil and Ethanol were pre-treated with 3Å MS
General reaction with cooking oils

- Catalyst: NaOH (0.25% ~ 0.5%) and 3Å MS (1% w/wt)
- TLC/ GC showed 100% conversion

![Diagram showing the reaction]

\[ \text{Cooking oil} + 3 \text{Ethanol} \rightarrow \text{Biodiesel} \]

Reaction was monitored by TLC and confirmed by GC
No soap formation was observed
General reaction (waste cooking oil)

- Catalyst: NaOH (0.25% ~ 0.5%) and 3Å MS (1% w/wt)

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WCO + 3 Ethanol → Biod. + Gly.
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55 °C Catalyst (18 minutes)

No soap formation was observed
Reaction was monitored by TLC and confirmed by GC
Biodiesel production experiment (2)

1. Cooking oil (6mL) + CH₃OH (3 mL) + NaOH (0.04g)
2. Waste Cooking oil (6mL) + CH₃OH (3 mL) + NaOH (0.044g)
3. Waste Cooking oil (6mL) + CH₃OH (3 mL) + chalk (0.06g)
4. Cooking oil (6mL) + CH₃OH (5 mL) + chalk (0.06g)
5. Cooking oil (12mL) + CH₃OH (3mL) + chalk (0.29g)
6. Cooking oil (0.01mL) + CH₃OH (2.5mL) + chalk (0.5g)
7. Cooking oil (4.4g) + CH₃ CH₂ OH (2 mL) + NaOH (0.5 % w/wt, 0.044g) + 3Å MS (1% w/wt, 0.088g)
8. Waste Cooking oil (4.4) + CH₃ CH₂ OH (2mL) + NaOH (0.04g) + 3Å MS (0.09g)
Process

**Stirring up and heating**

1. Follow the formula
2. Put it in a flask
3. Put the Stir bar in
4. Stir it until it all get mixed
5. Then start heating it until it reaches 50
6. Once it reaches 50 or almost 55 we start counting the minutes, we have decided that day we would be which are between 15-20 minutes

**Refluxing**

1. Follow the formula after setting
2. In the heating mantle, we have put all the ingredients
3. Put a tube in the heating mantle
4. Connect one of the tube to the water which is the bottom
5. Then at the top there should be another tube which is connect to the recipients containing our results
6. We turn on the water, then the heat and observes for one hour until we get something.
Findings

• 3A Molecular sieves, Water scavenger and base.

• If the temperature reaches higher than 55 °C it starts forming soap, a by-product.
• Molecular sieves (1 %) and NaOH (0.25~0.5 %) is also used as co-catalyst. This co-catalyst speed up the reaction, and produce 100% conversion, isolated yield 80~95%.
Results

• The reactions were monitored by TLC, showing no trace of starting material, proving 100% conversion, isolate yield 80 ~ 95%
• GC confirmed the Biodiesel formation
• Density
• Viscosity
Summary

This is an ongoing research, finding the environment friendly, recyclable catalyst in the biofuel production.

An optimal condition is studied by mixing 0.25~0.5 % wt NaOH and 1% wt 3Å MS at 55 °C for 15 mins.

No formation of soap is observed. 3Å MS can be recovered, dried, and reusable- testing its catalytic activity
Future Directions

• Employing different types of MS in Biodiesel production

• Replacing NaOH completely

• Finding recyclability of MS
My goals

My future goal, after obtaining my degree in Liberal Arts & Sciences (STEM track) at Guttman is to major in biology and neuroscience. I would like to become a neurosurgeon and research about how to cure diseases that occurs in our brains. The first time I fell in love with neuroscience was during my junior year of high school. I understand that during my career, I will have do many research to be able to find solutions. I believed that my research on campus, has helped me start learning how to do so and be careful of every step that I take or the impact of my mistakes, which is why I am really glad, to have gotten the opportunity to join the chemistry research group on campus.
Conclusions

1. Enhances the curriculum by extending learning beyond the classroom and allowing students to *apply what they’ve learned to real-world situations*; provides opportunities for *critical reflection*; and extends to service learning and civic engagement.

2. Recruit, retain and graduate underrepresented students: impact, longevity, and overall success.
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