Chemical Engineering

Advisory Board Meeting

11-12 April 2024

United States Military Academy
Department of Chemistry and Life Science

Timeline: Key Sessions

0800 – 0830 **Session 1:** Introduction and ABET

0830 – 0915 **Session 2:** Assessment & Program Objectives

0930 - 0945 **Session 3:** Mission Statement & PEOs Feedback

1000 – 1145 **Session 4:** Board and Cadets Mixer (Small Groups)

1330 – 1530 **Sessions 6, 7, 8:** Brainstorming with Faculty (Small Groups)

- Mission Statement and PEOs
- Growth of Program (Senior Lab Re-design)
- Department Name and Undergraduate rankings

Meeting Goals

1. Advisory Board Members Roles
   - Assessment Data
   - Objectives Assessment (ABET)
   - Curricular Challenges
   - Complete Surveys

2. Board Members have discussions with chemical engineering faculty and cadets

3. Board Members review mission statement, PEOs and future challenges with the anticipated growth of the program/major.

Chemical Engineering

Advisory Board Meeting

11-12 April 2024

1. Introductory Remarks

COL Corey James Ph.D., Deputy Head CLS

United States Military Academy
Department of Chemistry and Life Science

Chemical Engineering

2. ABET Accreditation

LTC Sam Cowart Ph.D.

Accredited **1 October 2012** to present
Next Record Year: **AY2025-2026**
ABET Visit: **Early September 2026**

United States Military Academy
Department of Chemistry and Life Science

Why ABET Accreditation?

- Confidence that program has met standards essential to prepare graduates to enter STEM fields
- Keeps us in touch with the engineering profession
- Helps USMA (and ChemE) recruiting (2020 – 29; 2021 - 20; 2022 - 23; 2023 -*13; 2024 ~21; 2025~31; 2026~28; 2027~43*)
- Provides important opportunities for graduates
- Allows USMA engineering majors to take the Fundamentals of Engineering (FE) Exam
- It is required by Army Regulations (10-87).

ABET Definitions

Program Educational Objectives

Program educational objectives are broad statements that describe what graduates are expected to attain within a few years of graduation.

Student Outcomes

Student outcomes describe what students are expected to know and be able to do by the time of graduation (skills, knowledge, and behaviors).

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Key Terminology

- **Program Educational Objectives (PEOs)**
  - Gleaned by asking *program constituents*
    - For us: Army, profession, graduate schools, other
  - **Our external *Advisory Board* a key resource.**
  - Desired professional accomplishments of graduates **5-7 years after graduation**
  - Adjust every 3 years or so…

- **Student Outcomes**
  - What students should be able to do **at graduation**
  - Must be **measurable**
  - Designed to lead naturally to the PEOs
  - Assess/evaluate some fraction yearly.

- **Assessment → Continuous improvement**
  - Collect meaningful data to evaluate performance indicators (PIs)
  - Assess PIs for outcome attainment → information → COAs for change
  - Implement change
  - Assess its effects and level of success (“closing the loop”)
  - Repeat all the above
  - Periodically check and adjust both Student Outcomes and PEOs

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2. Program Assessment and Objectives

Prof. Andrew Biaglow

United States Military Academy
Department of Chemistry and Life Science

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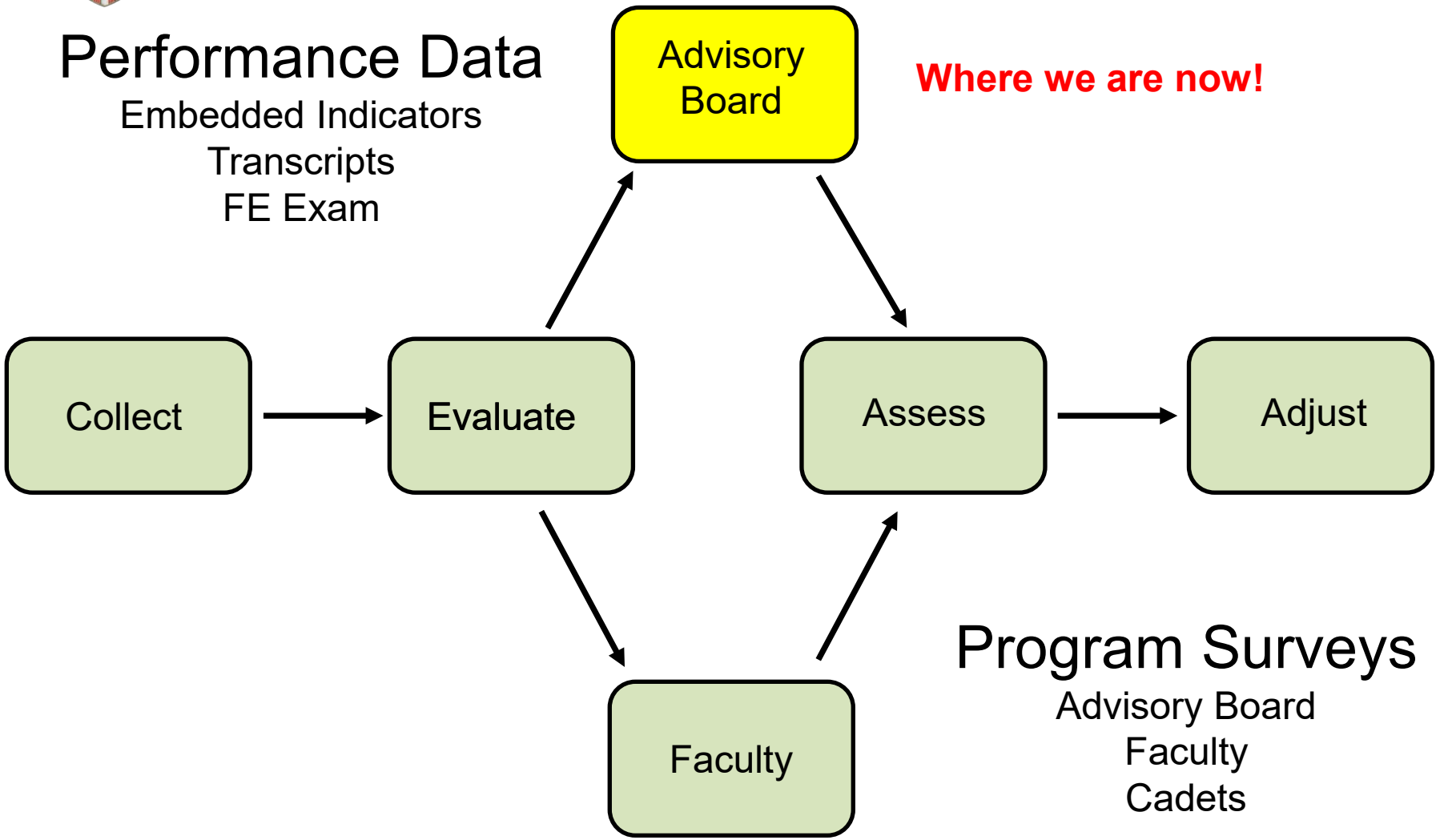
Assessment Process

Performance Data

Embedded Indicators
Transcripts
FE Exam



Where we are now!

Program Surveys

Advisory Board
Faculty
Cadets

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ABET Student Outcomes (AY19 & beyond)

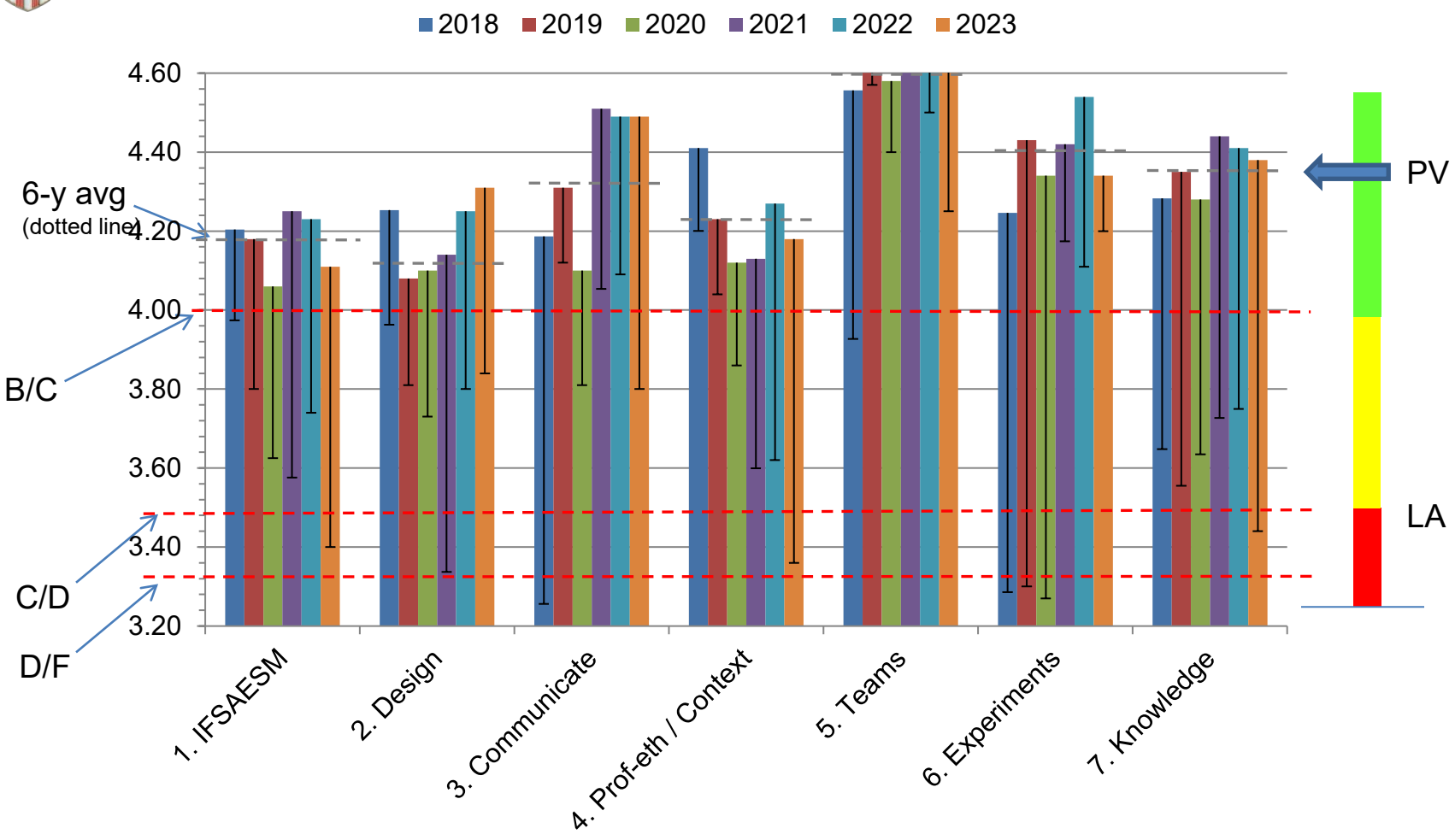
Identical to ABET 1-7 plus one additional outcome (8)

On completion of the chemical engineering program, our graduates will be able to:

1. Identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. Apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. Communicate effectively with a range of audiences.
4. Recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. Function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. Develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
7. Acquire and apply new knowledge as needed, using appropriate learning strategies.
8. Understand the chemical engineering curriculum, including chemistry, material and energy balances, safety and environmental factors, thermodynamics of physical and chemical equilibria, heat, mass, and momentum transfer, chemical reaction engineering, continuous and staged separation processes, process dynamics and control, modern experimental and computing techniques, and process design.

Performance on Embedded Indicators

Program Averages AY2018-23

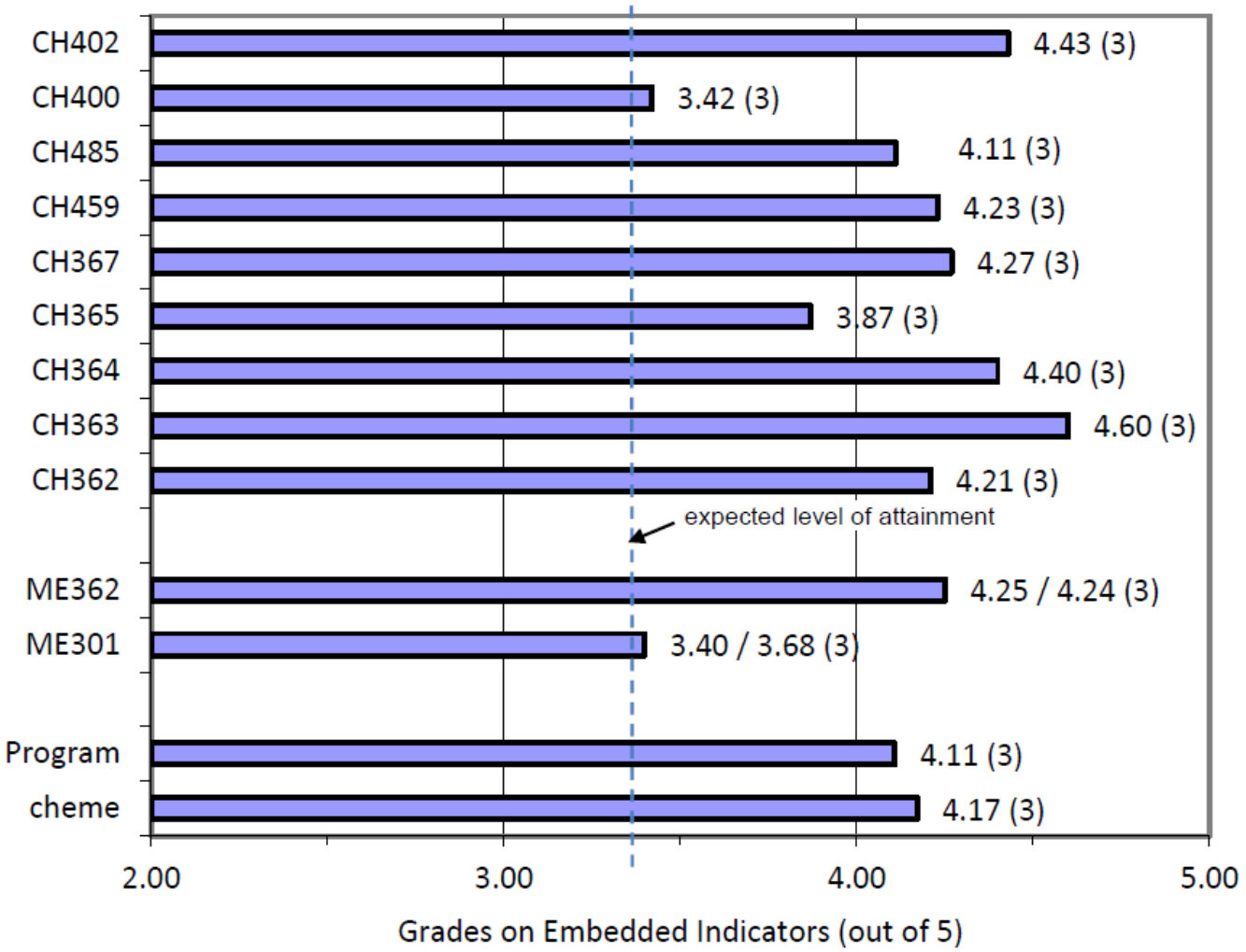


Error bars are minimum scores from course assessments.

Expected levels of attainment are the 6-year averages

Example Data: Coursework Embedded Indicators

Student Outcome 1



ME301 and ME362 have two scores. The first is for chemical engineering and the second is course-wide.

Values in parentheses are coverage ratings from Table 5-4

Rubric:.

3: Unique embedded indicator with clear rubric or cut scale.

2: Outcome was graded but grades are convoluted, or part of the outcome is not covered.

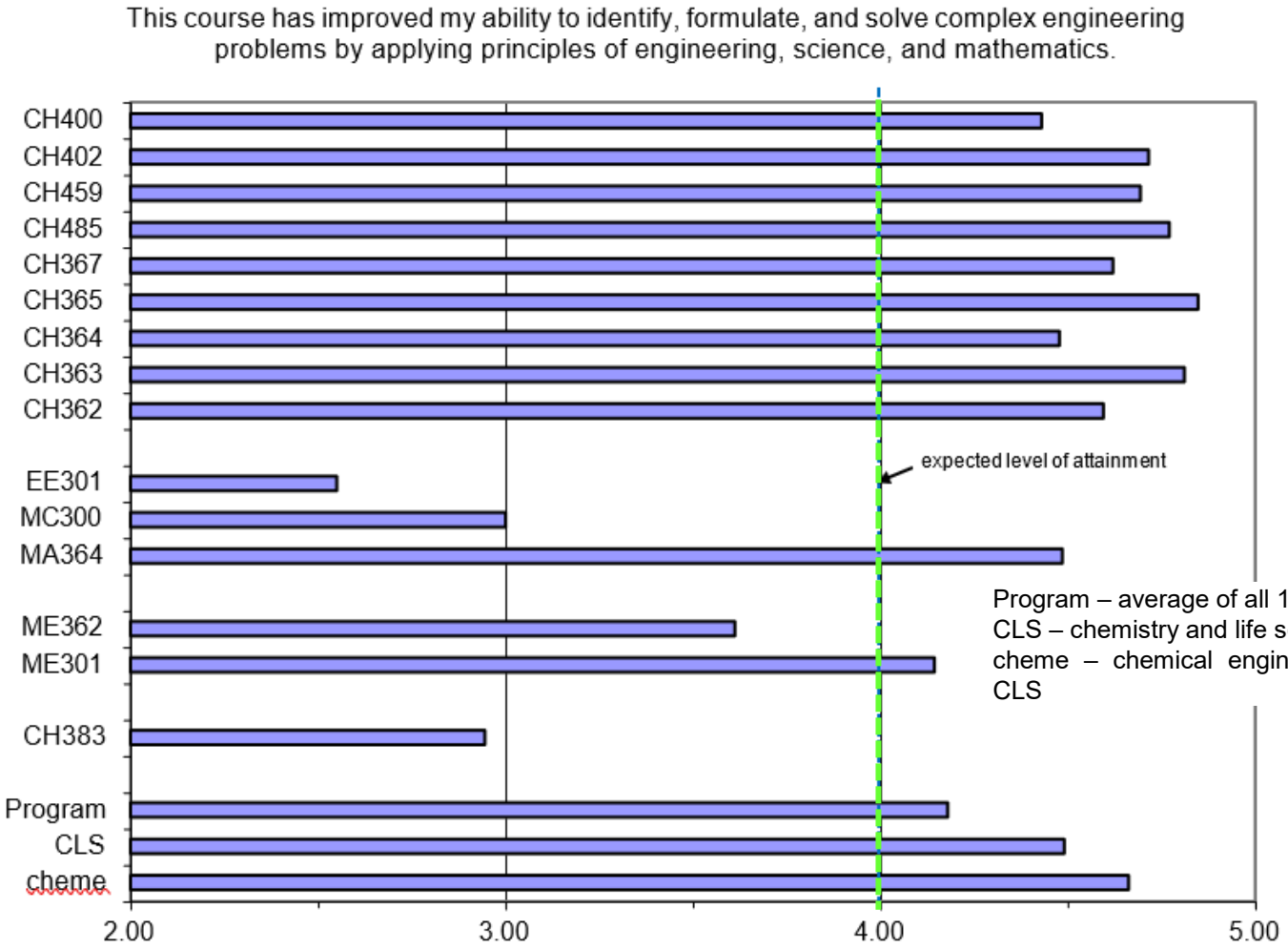
1: Correlation to outcome but no assessment

0: No coverage or correlation

Data shown here is for Class of 2023
Similar data is collected for all 7 ABET student outcomes
Summary of all data is shown on next slide

Example Data: End-of-Semester Surveys

Student Outcome 1

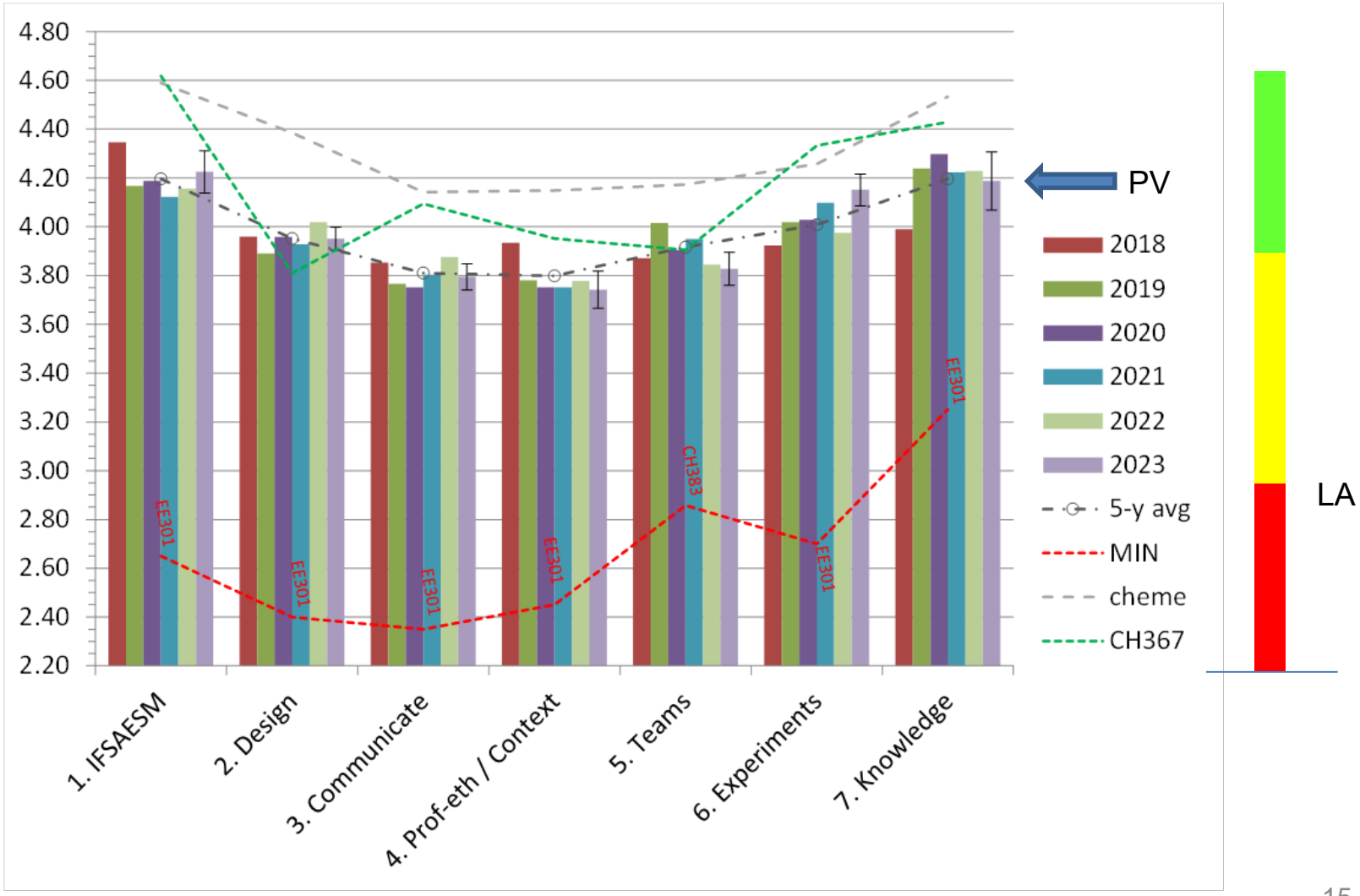


Program – average of all 15 courses above
CLS – chemistry and life science courses
cheme – chemical engineering courses in CLS

Data shown here is for Class of 2023
Similar data is collected for all 8 ABET student outcomes
Summary of all data is shown on next slide

End-of-Semester Surveys Program Aves. From AY18-AY23

Error bars are standard deviations.
Expected level of attainment is the 6-year average



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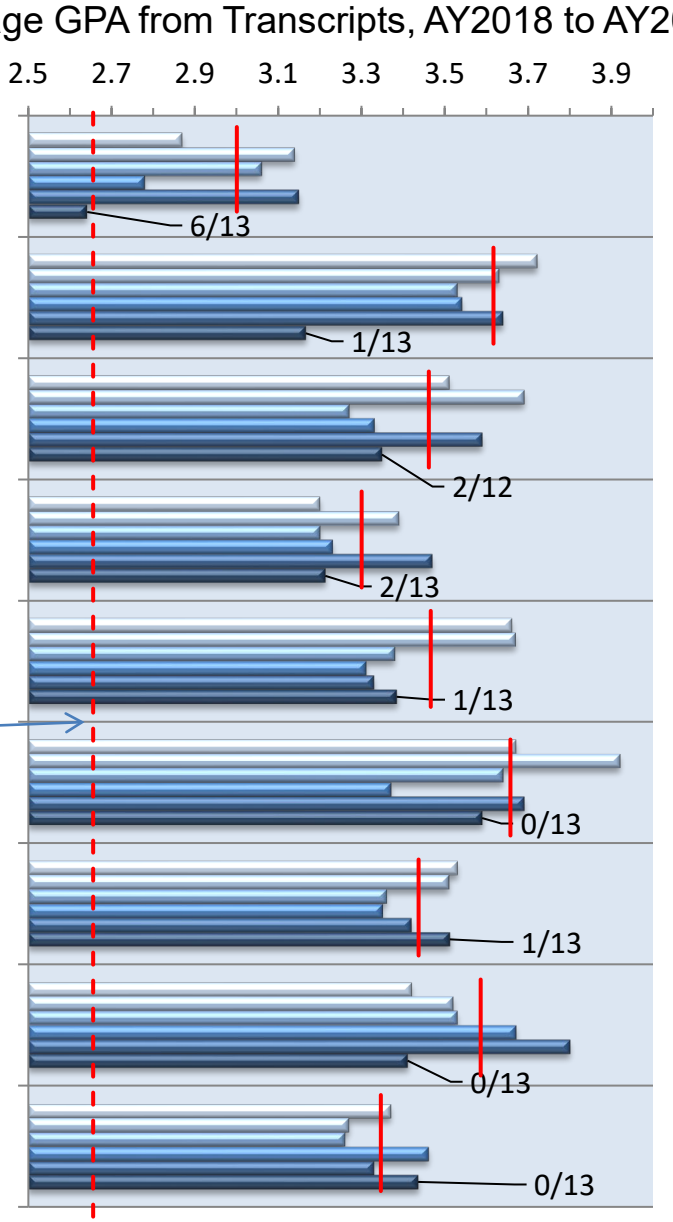
Topical Outcomes Evaluation

Student Outcome 8: Understanding of the Chemical Engineering Curriculum

Average GPA from Transcripts, AY2018 to AY2022



expected level of attainment for the program is B- (2.67, red dotted line).

Letter Grade	Grade Point Conversion
A+	4.33
A	4.00
A-	3.67
B+	3.33
B	3.00
B-	2.67
C+	2.33
C	2.00
C-	1.67
D	1.00
F	0.00

Chemical Engineering

2. Program Assessment and Objectives (continued)

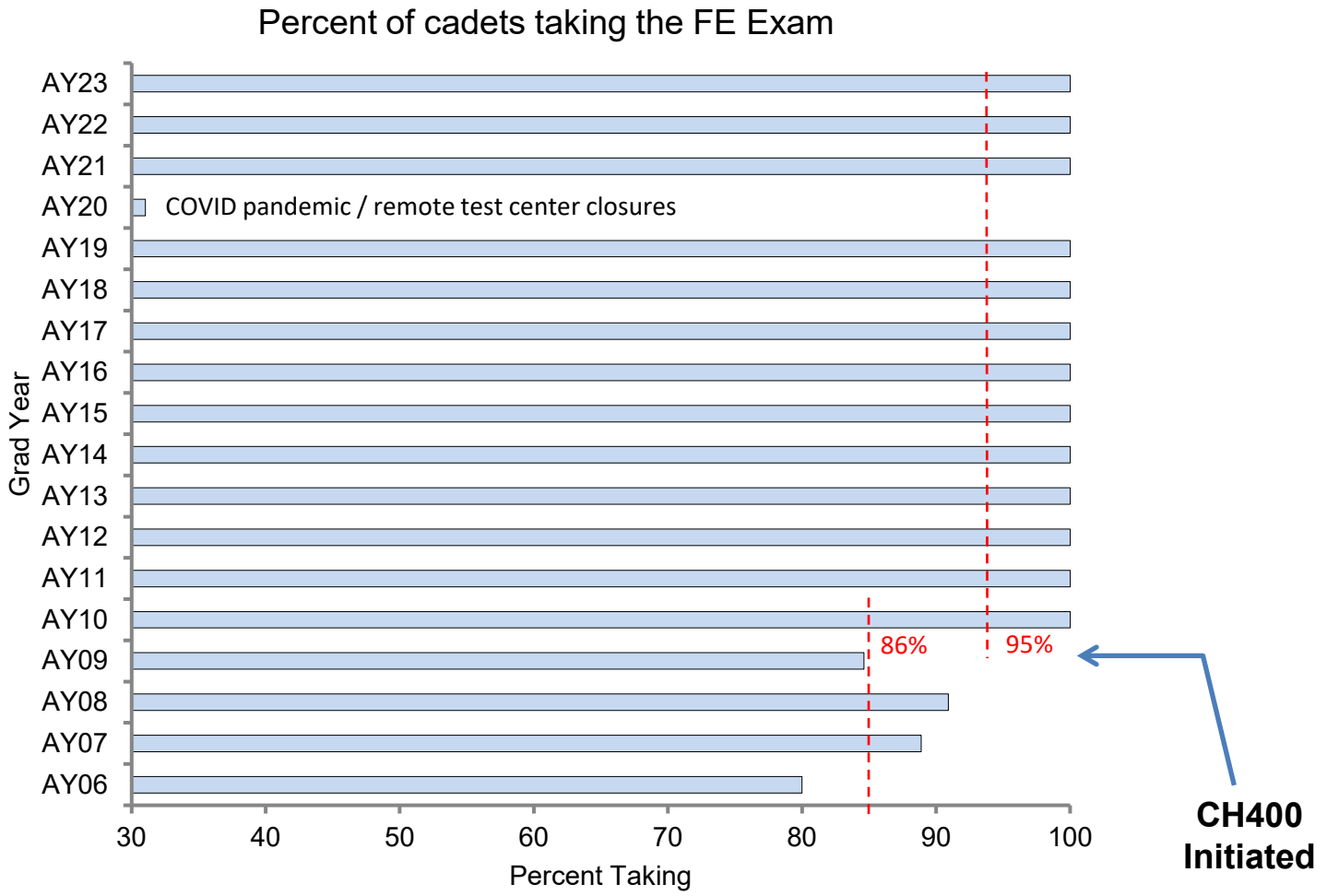
Dr. Enoch Nagelli

United States Military Academy
Department of Chemistry and Life Science

Fundamentals Engineering Exam Results

Fundamentals of Engineering Exam

Student Outcome 7: Acquire and apply new knowledge as needed, using appropriate learning strategies



Student Outcome 7: Acquire and apply new knowledge as needed, using appropriate learning strategies

National, (+/- ~1%):

2023	70.2%
2022	70.7%
2021	74.0%
2020	74.6%
2019	77.0%
2018	75.0%
2017	74.0%
2016	79.0%
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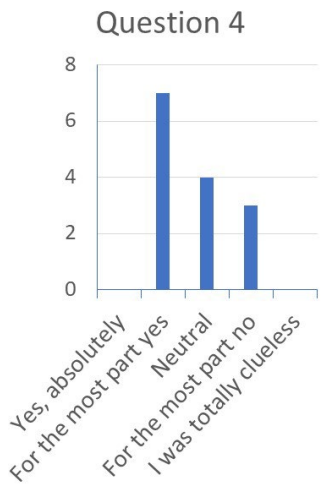
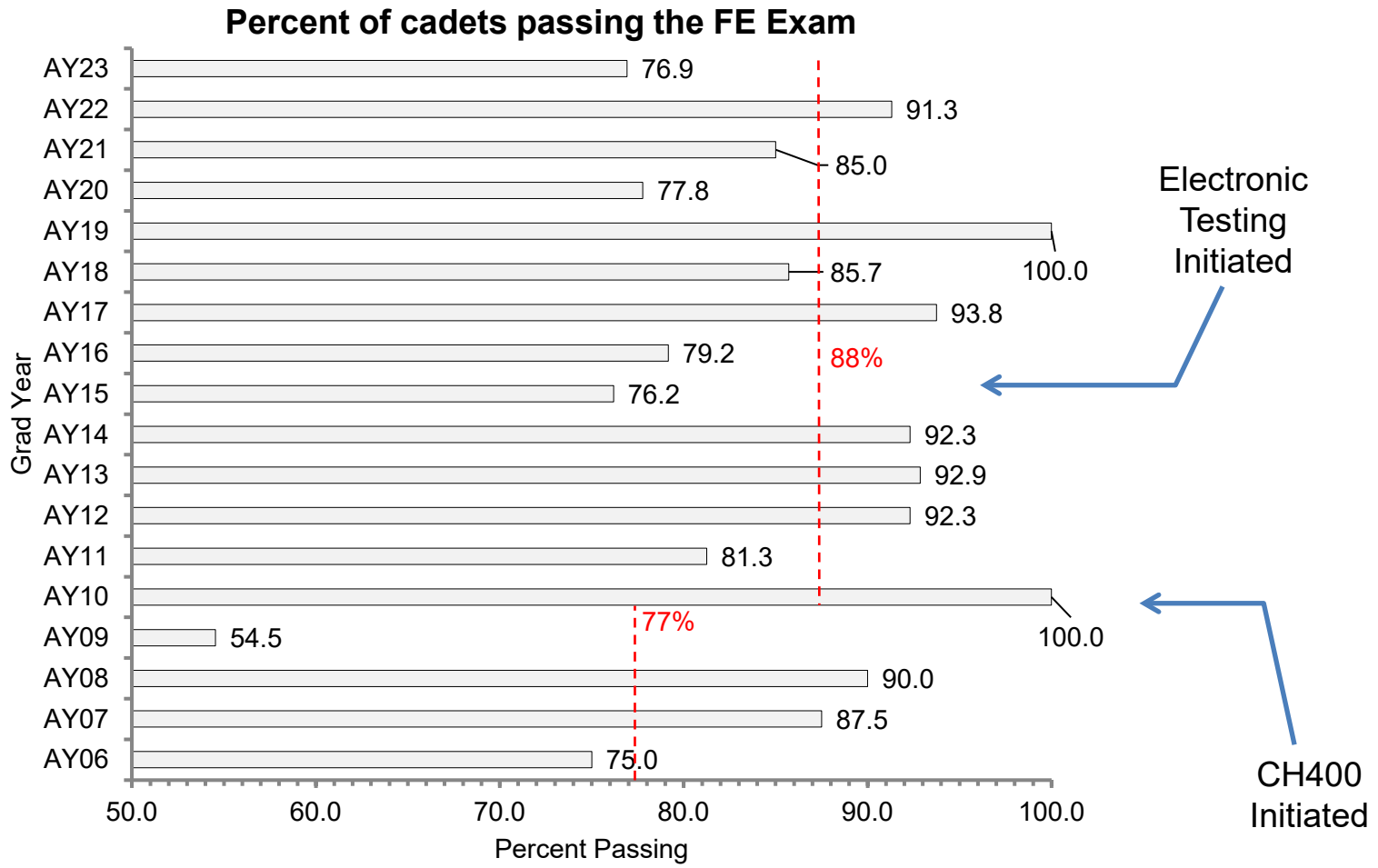
2015	77.4%
2014	89.0%
2013	86.3%
2012	85.1%
2011	87.0%
2010	87.0%
2009	84.0%
2008	87.0%
2007	87.0%
2006	87.0%

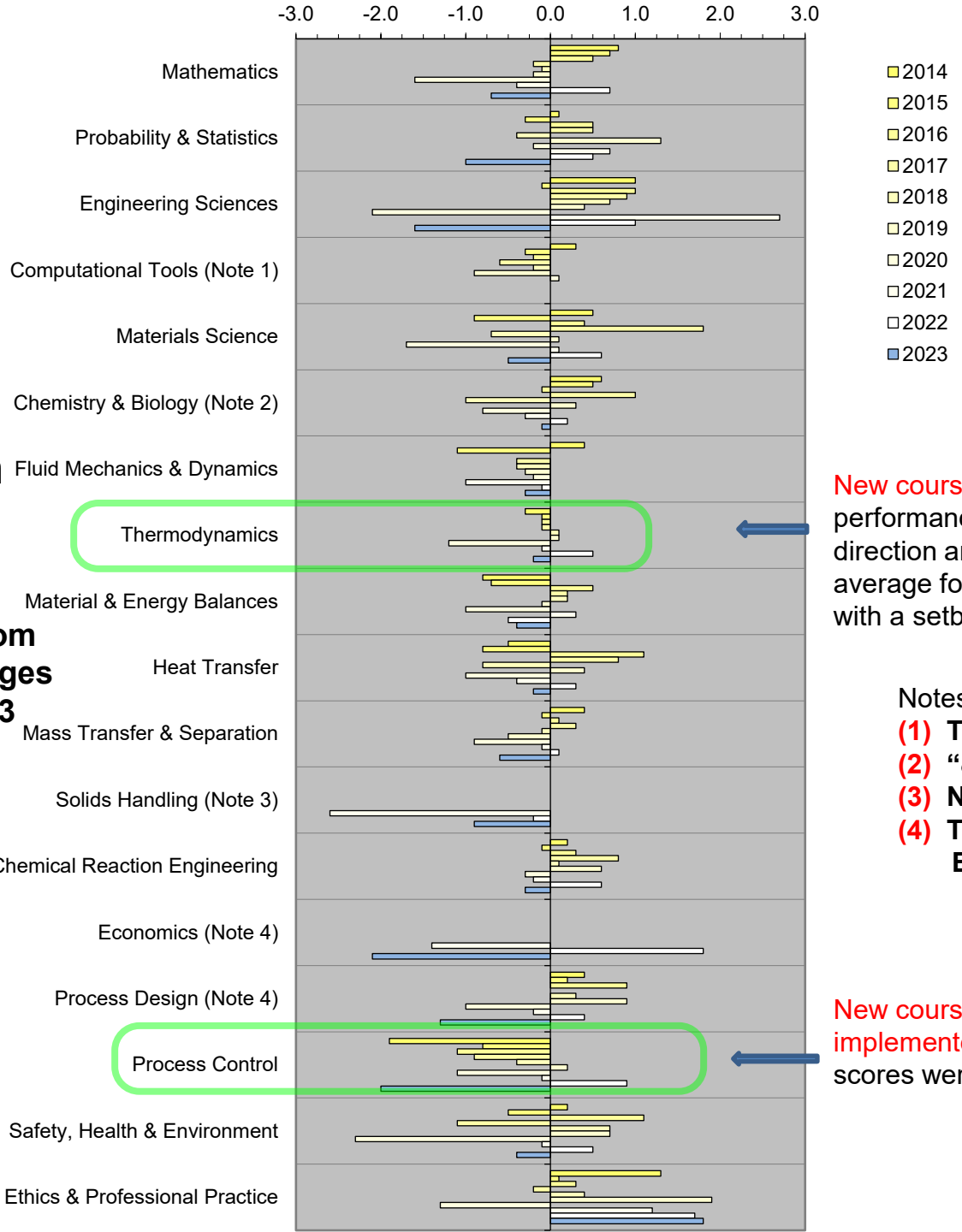




Question 4, Post FEE Survey: For the questions on the exam that seemed new to you, were you able to learn the material on the spot?

Topical Outcomes Evaluation

Deviations from National Averages AY14 to AY23



New course added in AY13. Trend in performance continues in the right direction and has been near the national average for several successive years, with a setback in AY20 due to COVID-19

Notes:

(1) This topic was dropped in 2021.
(2) "& Biology" added in 2021
(3) New exam spec in 2021
(4) Topic was "Process Design & Economics" before 2020

New course added in AY16 and implemented in AY19-2. Before that, scores were always very low.

Expected level of attainment is the national average (0.0 line)

Break

0915-0930

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3. Faculty, Board, and Cadet Feedback

Prof. Andrew Biaglow

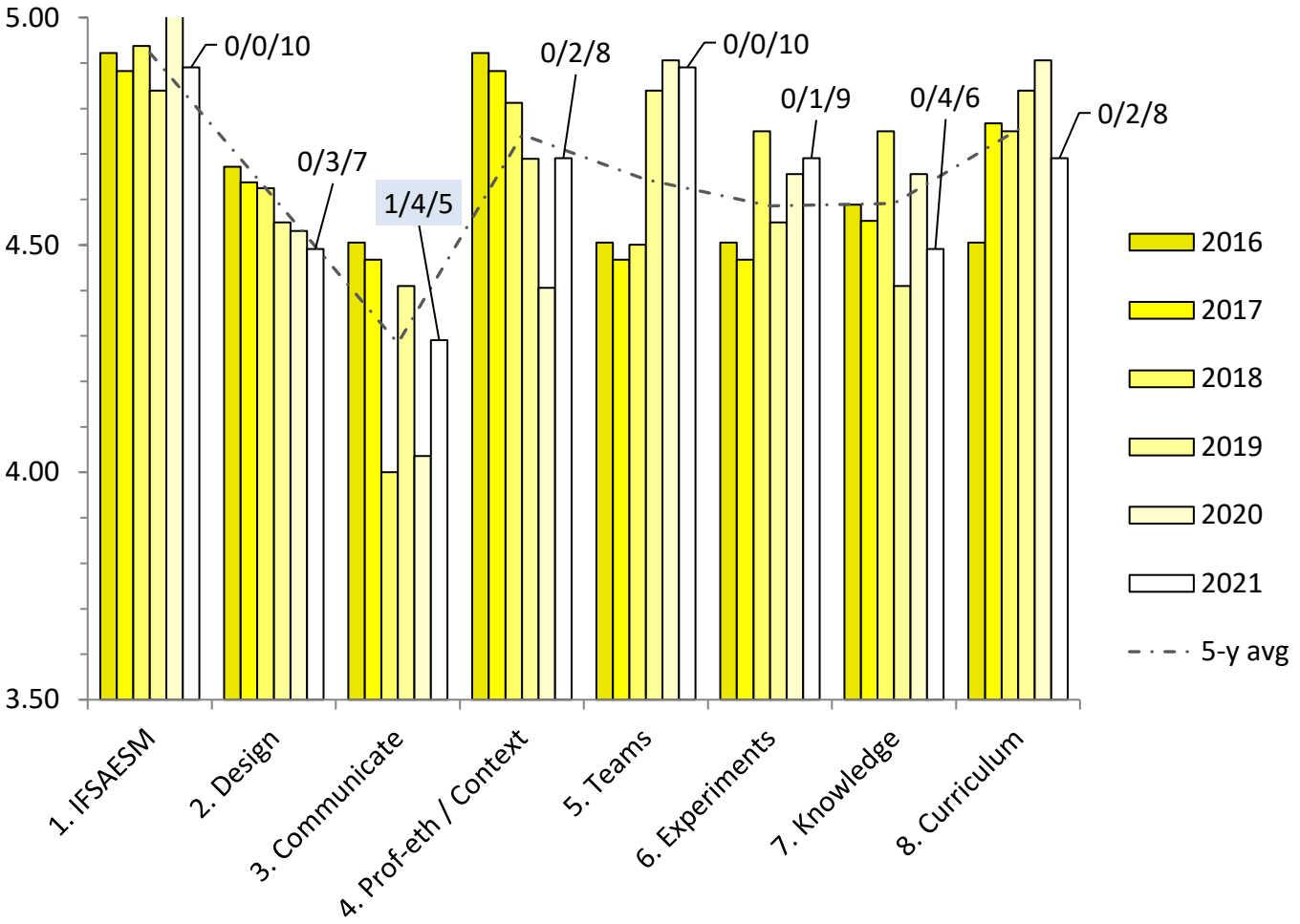
United States Military Academy
Department of Chemistry and Life Science

Faculty Student Outcomes Surveys

Student Outcomes 1-8

Program Averages from AY16-21

Data labels are response frequencies on the 1-5 Survey Likert Scale (# of 3 / # of 4 / # of 5).
The average standard deviation is 0.46 and ranges from .00 to .70.

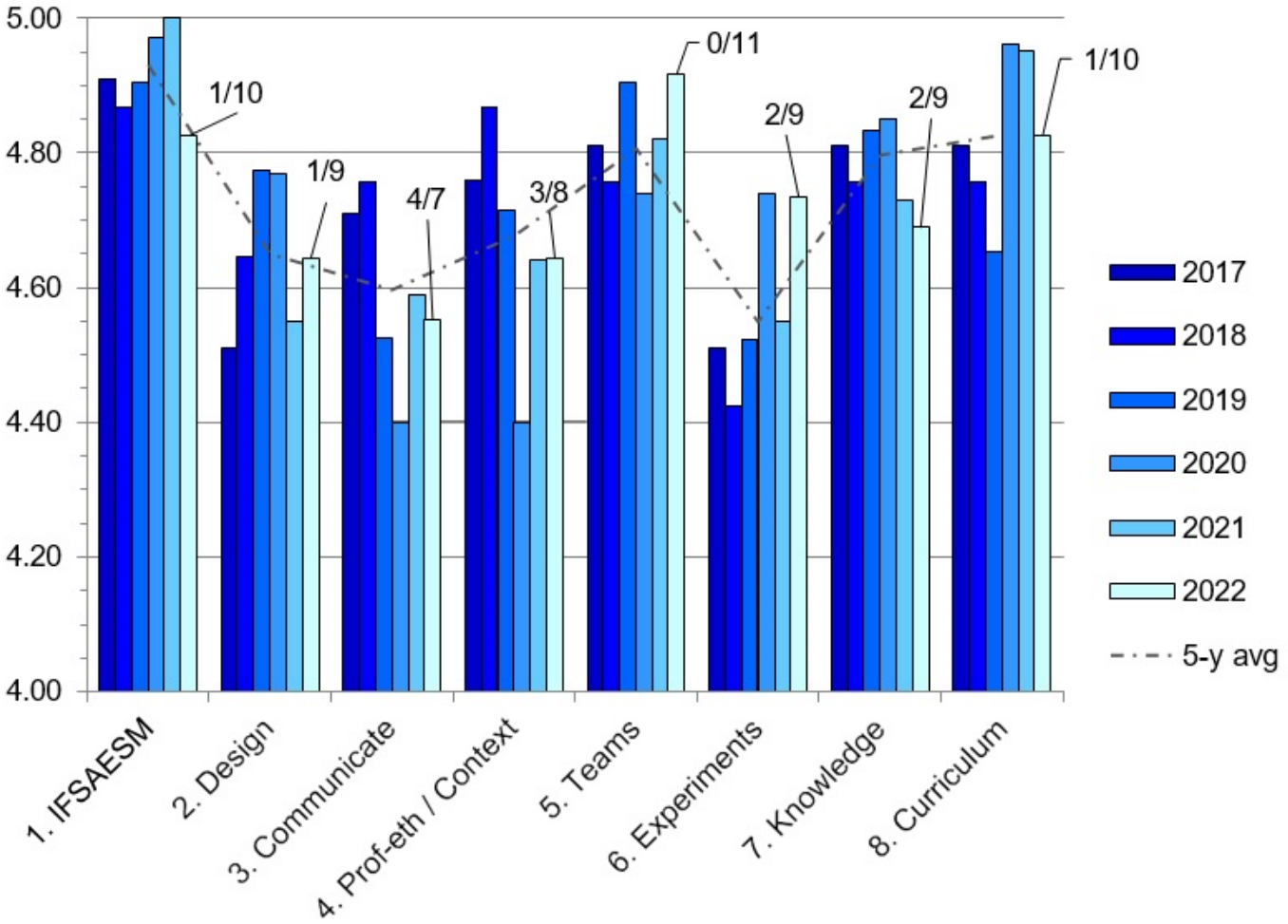


Advisory Board Student Outcomes Surveys

Student Outcomes 1-8

Program Averages from AY17-22

Data labels are response frequencies for 4 or 5 (# of 4s / # of 5s) on the 1-5 Survey Likert Scale
Standard deviations range from .00 to .52



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ChemE Vision Statement AY23 Board Feedback

Mission:

The mission of the chemical engineering program is to prepare commissioned leaders of character who possess the intellectual capital to leverage new and emerging technologies. ~~are proficient in applying chemical and engineering principles to solve problems in a complex operational environment~~.

During a career as commissioned officers in the United States Army and beyond, program graduates:

(1) Demonstrate effective leadership and chemical engineering expertise.
(2) Contribute to the solution of infrastructure or operational problems in a ~~complex~~ operational environment.
(3) ~~Succeed in graduate school or other advanced study programs.~~ Apply disciplined technical expertise to succeed in advanced study programs or graduate school.
(4) Advance their careers through clear and precise technical communication.

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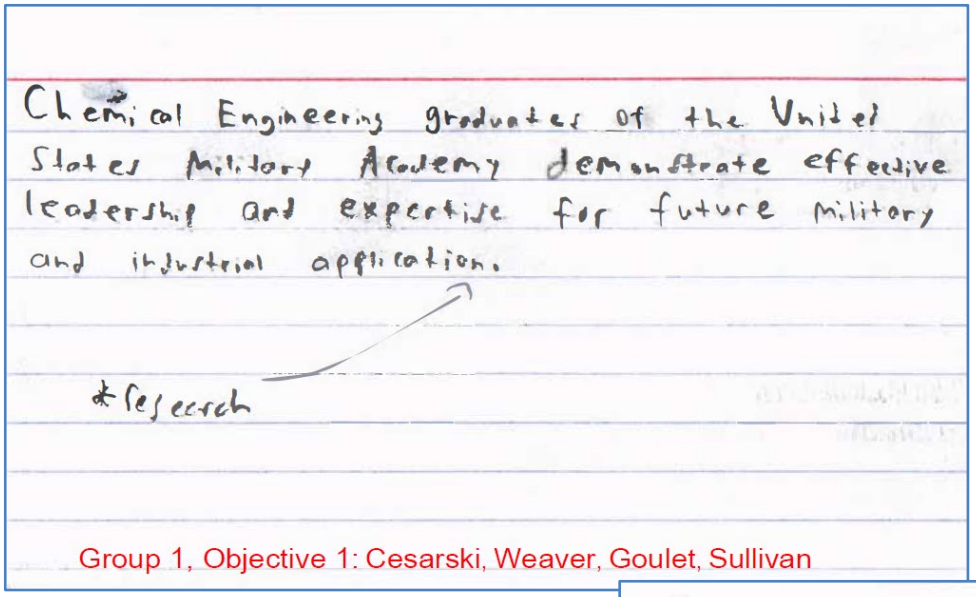
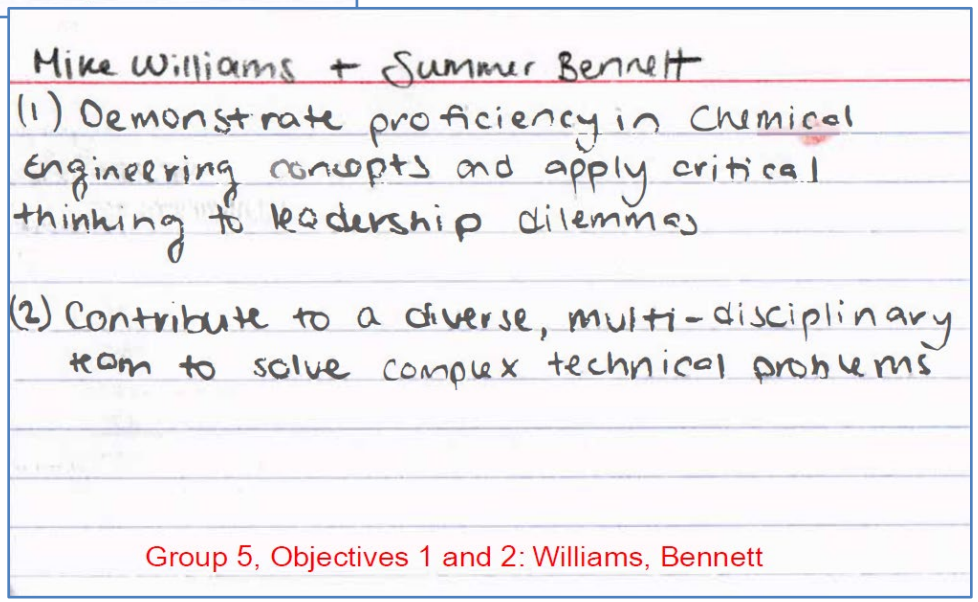
Vision Statement & PEOs Cadets Feedback

Objective 1
Cadet Cards (Drafts)



Group 1, Objective 1: Cesarski, Weaver, Goulet, Sullivan

Currently: During a career as commissioned officers in the United States Army and beyond, program graduates demonstrate effective leadership and chemical engineering expertise.



Group 5, Objectives 1 and 2: Williams, Bennett

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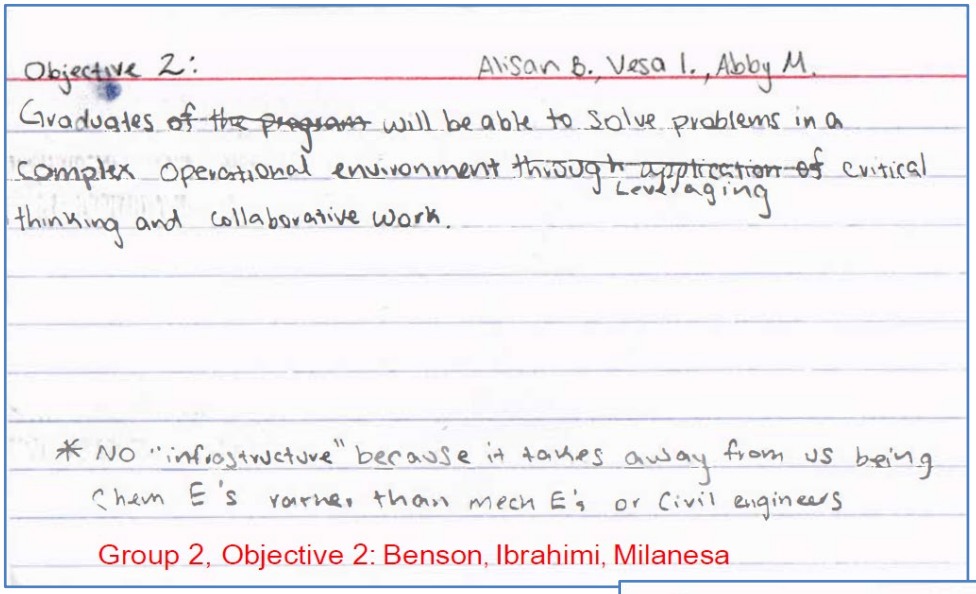
Vision Statement & PEOs Cadets Feedback

Objective 2
Cadet Cards (Drafts)

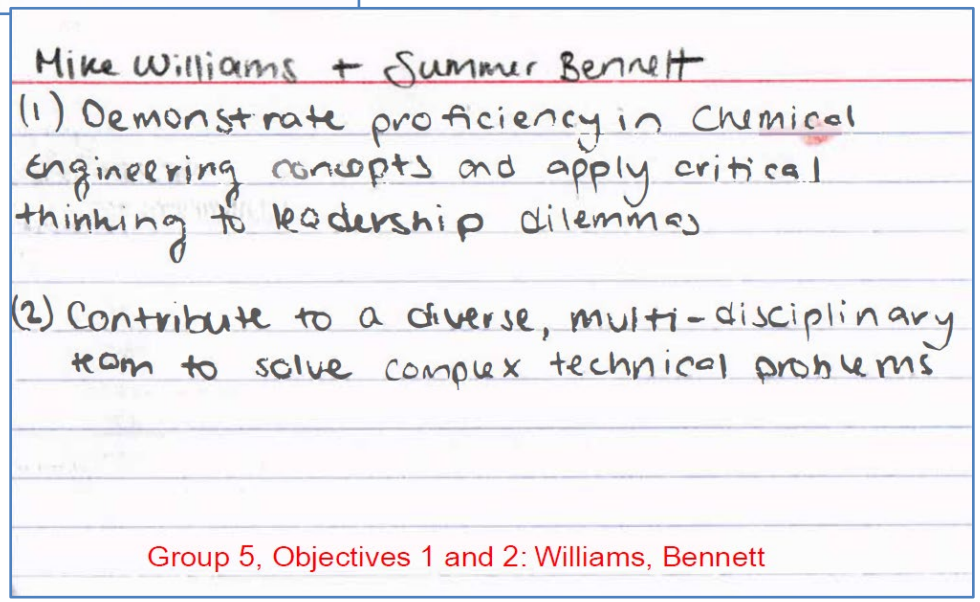

Objective 2: Alisan B., Vesa I., Abby M.

Graduates ~~of the program~~ will be able to solve problems in a complex operational environment ~~through application of~~ Leveraging critical thinking and collaborative work.

* NO "infrastructure" because it takes away from us being Chem E's rather than mech E's or Civil engineers

Group 2, Objective 2: Benson, Ibrahimi, Milanesa

Currently: During a career as commissioned officers in the United States Army and beyond, program graduates demonstrate effective leadership and chemical engineering expertise.


Mike Williams + Summer Bennett

(1) Demonstrate proficiency in Chemical Engineering concepts and apply critical thinking to leadership dilemmas

(2) Contribute to a diverse, multi-disciplinary team to solve complex technical problems

Group 5, Objectives 1 and 2: Williams, Bennett

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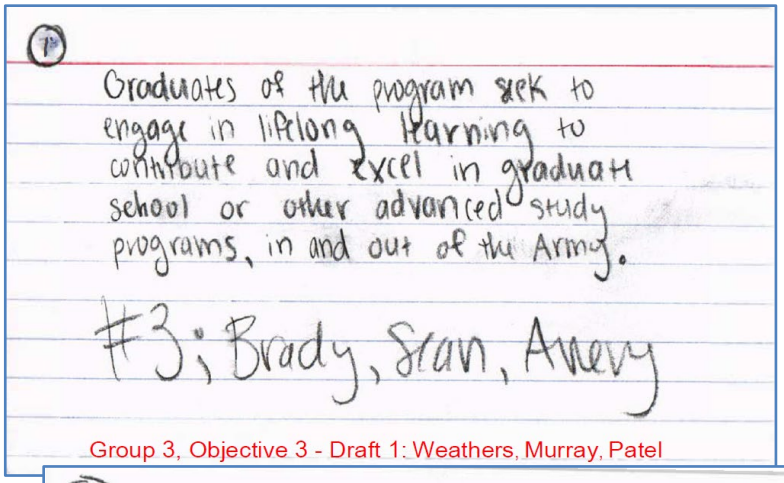
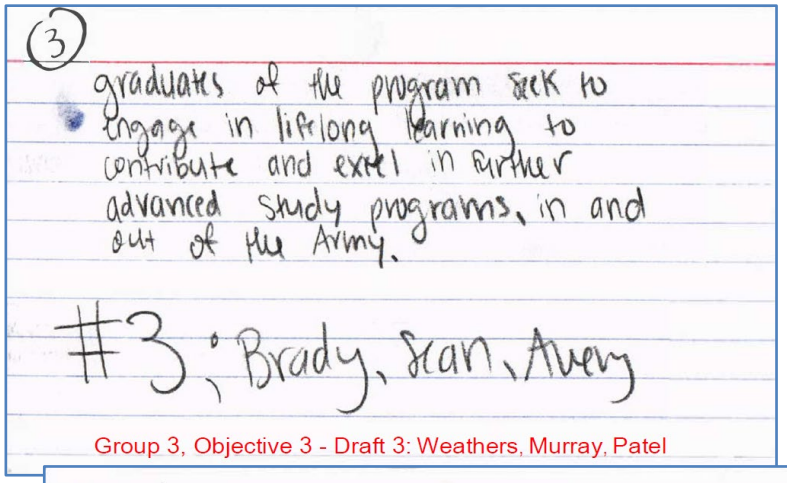
Vision Statement & PEOs Cadets Feedback

Currently: During a career as commissioned officers in the United States Army and beyond, program graduates succeed in graduate school or advanced study programs.

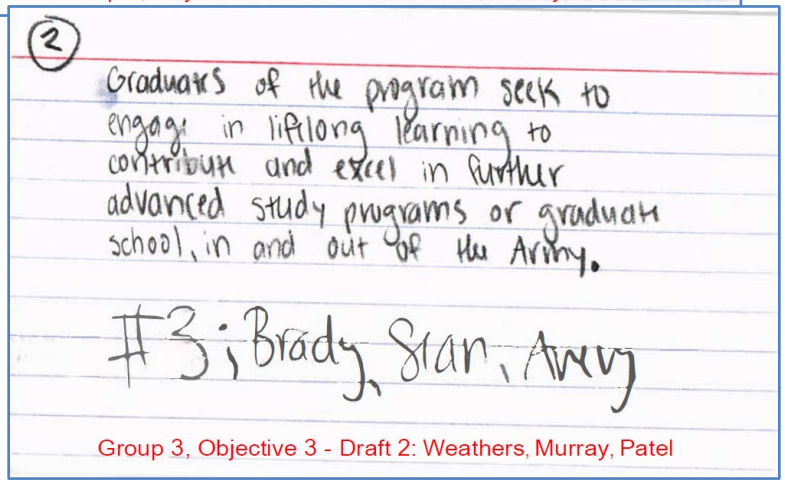
Objective 3
Cadet Cards (Drafts)



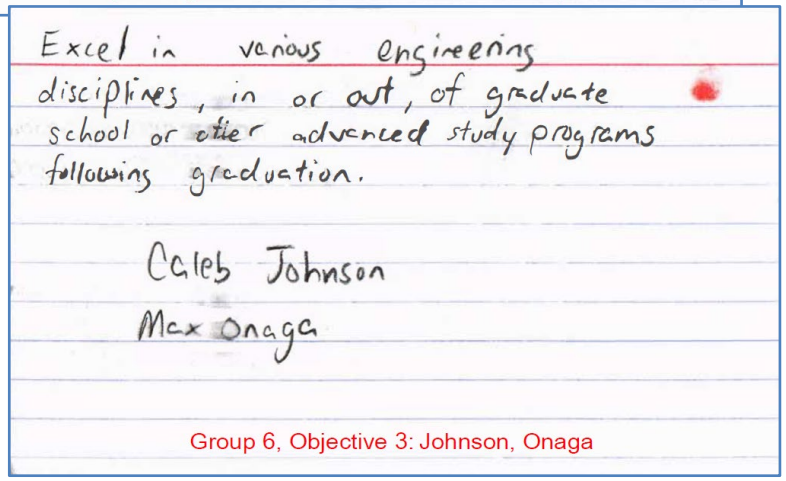
Group 3, Objective 3 - Draft 1: Weathers, Murray, Patel



Group 3, Objective 3 - Draft 3: Weathers, Murray, Patel



Group 3, Objective 3 - Draft 2: Weathers, Murray, Patel



Group 6, Objective 3: Johnson, Onaga

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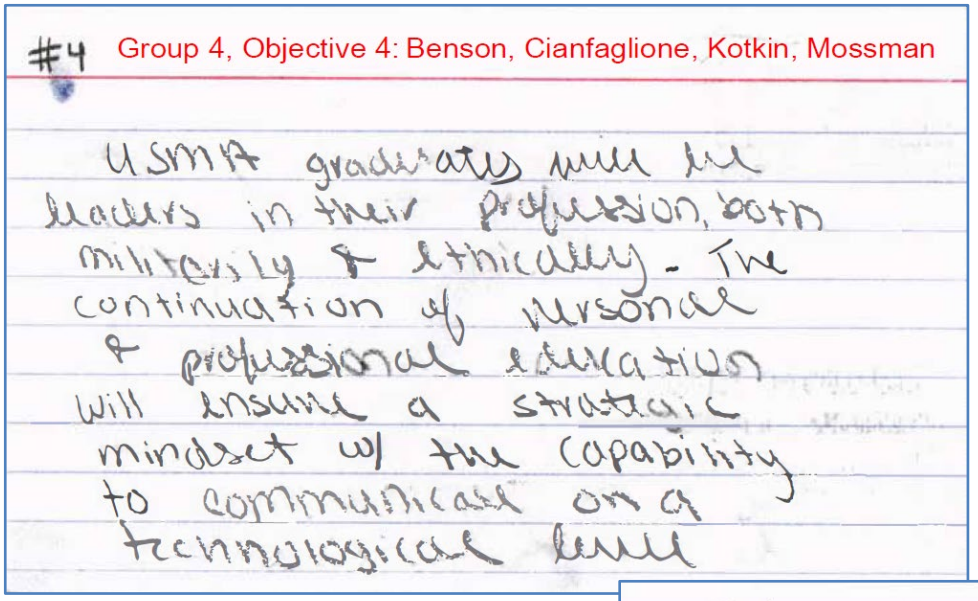
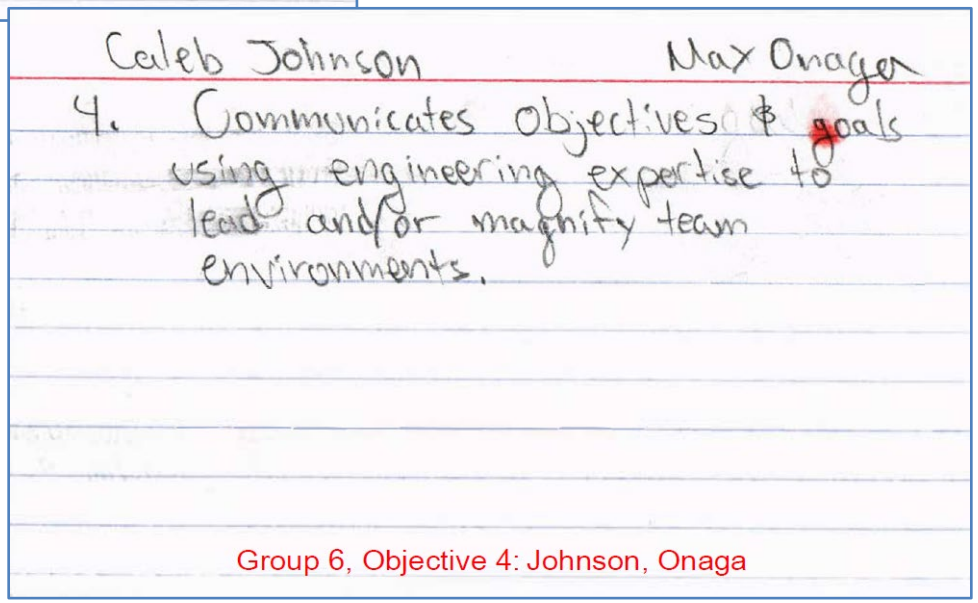
Vision Statement & PEOs Cadets Feedback

Objective 4
Cadet Cards (Drafts)


#4 Group 4, Objective 4: Benson, Cianfaglione, Kotkin, Mossman

USMA graduates will be leaders in their profession, both militarily & ethically - The continuation of personal & professional education will insure a strategic mindset w/ the capability to communicate on a technological level

Currently: During a career as commissioned officers in the United States Army and beyond, program graduates advance their careers through clear and precise technical communication.


Caleb Johnson Max Onager

4. Communicates objectives & goals using engineering expertise to lead and/or magnify team environments.

Group 6, Objective 4: Johnson, Onaga

AY23 Advisory Board Feedback

Excerpts from Minutes of 14 April 2023 Meeting

- Reconsider MC300 and its role in the curriculum,
- Adding Organic Chemistry 2 to the curriculum and removing redundant material.
- Interactions in smaller groups to facilitate conversations (round-robin interviews, lunches).
- Tours for new members, such as cadet mess, museum, visitor center.
- More interactions with faculty.
- Student orientation on surveys.
- Faculty are appreciated by cadets.

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4. Cadets and Board Panels

LTC Sam Cowart Ph.D.

United States Military Academy
Department of Chemistry and Life Science

Discussions with Cadets (Firsties & Cows)

Suggested talking points:

- Program Sustains/Improves
- Any courses in curriculum cadets are unhappy with?
- Any general issues with the program they would like to discuss?
- Any thoughts on fundamental courses preparing the cadets for upper level courses (i.e. EE301 prep for CH367, CH362 prep for pretty much everything else, ME362 prep for CH485, ME301 prep for CH365, etc.)
- Any thoughts on structure of labs associated with most courses (vice a dedicated lab course per year/semester).
- For Firsties: If you were going into the civilian job market as a new engineer, do you feel prepared?

Small Group Panels with Board Members Class of 2024 and 2025 Cadets (Cows and Firsties)

Timeline:

0950-1000 Cadets Arrive: Firsties and Cows (C1 Hour)

1000-1050 Session 4: Small Groups with Cadets & Board

1050-1100 Cadets Arrive: Cows (D1 Hour) join Firsties

1100-1145 Session 4 (cont): Small Groups with Cadets & Board

1145- 1300 Lunch

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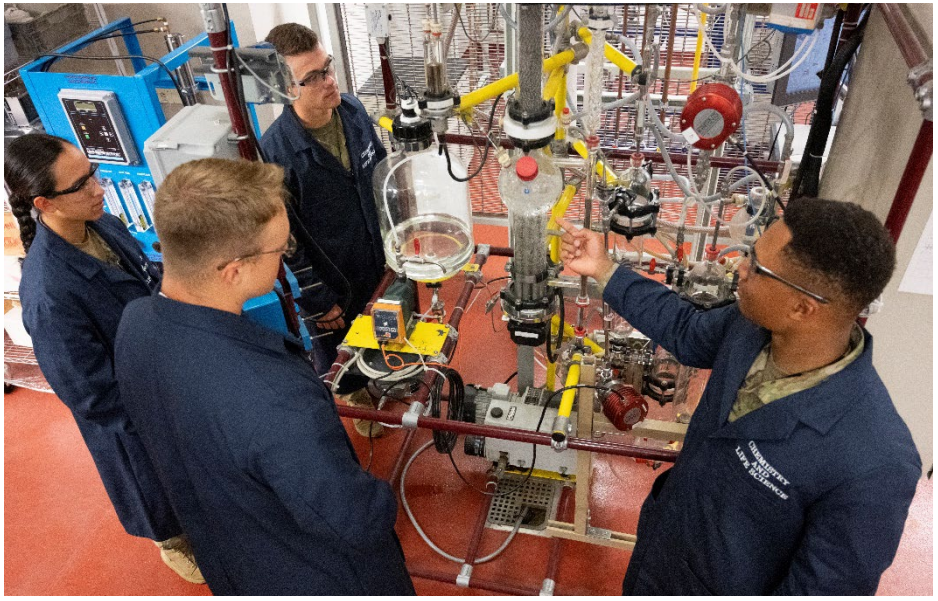
Lunch – Sandwiches and Chips

1145- 1300 Lunch with Firsties



Menu:
1. Cold cut sub sandwiches (Italian/turkey/ham&cheese)
2. Chips: regular/barbeque/sour cream & onion/Cheetos/Doritos
3. Water

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4. Advisory Board Survey (Part 1)

Dr. Enoch Nagelli

United States Military Academy
Department of Chemistry and Life Science

Advisory Board Completes Survey Part 1

Chemical Engineering

5. Small Groups Panel with Faculty

Dr. Nagelli & LTC Cowart

United States Military Academy
Department of Chemistry and Life Science

Small Group Discussion Topics

1. PEOs Workshop (1330-1400)

2. Future Challenges (1400-1500)
   - Growth of Major (Class of 2027 = 43 cadets!)
   - Unit Operations Lab (Senior Lab) Design of Course
     - *Current = 2 round robin (3 experiments in each)*
   - Instructor Teaching Load/Resourcing
     - *3 sections for each course?*

3. Department Name and Undergraduate Rankings (1500-1530)

Program Educational Objectives (Session 5 Topic 1)

During a career as commissioned officers in the United States Army and beyond, program graduates:

1. Demonstrate effective leadership and chemical engineering expertise.

2. Contribute to the solution of infrastructure and operational problems in a complex operational environment.

3. Succeed in graduate school or advanced study programs.

4. Advance their careers through clear and precise technical communication.

Advisory Board Recommended: **October 2012**

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Re-design of Unit Operations Lab (Session 5 Topic 2)

Provides laboratory experience in selected chemical engineering unit operations.

Round Robin 1

Round Robin 2

- Fuel Cell
- Distillation Column
- Reactor
- Absorber
- Cooling Tower
- Evaporator

Rotates at 2-week interval.

Written Products:

1) Poster
2) Technical Report
3) Executive Summary

Chemical Engineering

4 (cont). Advisory Board Survey (Part 2)

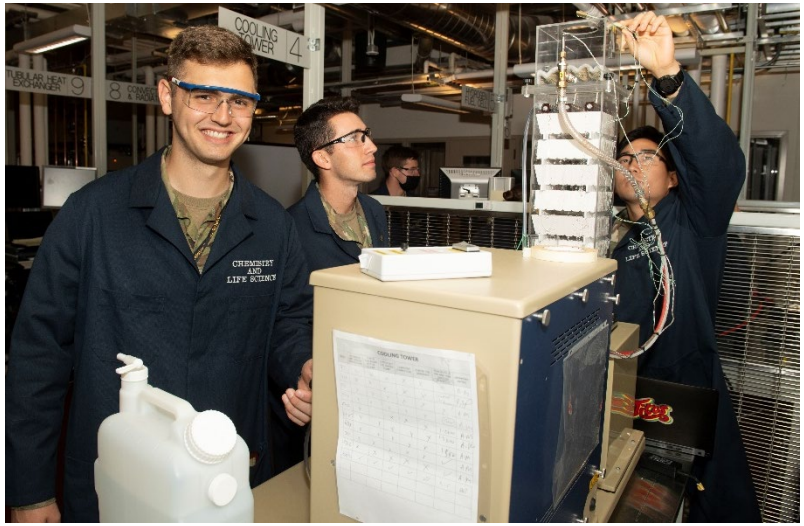
Dr. Enoch Nagelli

United States Military Academy
Department of Chemistry and Life Science

Advisory Board Completes Survey Part 2

Thank you!

- For the opportunity to show you America's Military Academy
- For your service and insights to help our program improve
- For the time you have dedicated to this visit
- For your dedication to the profession



Admin Notes for End of Meeting

- Next Advisory Board on-site
  - Early/Late April 2025…close out Class of ’24
- Travel Paperwork/Receipts
  - DTS Voucher Mrs. Kristen Costain
- Tour of Unit Operations Lab and BH labs…UTC
- Shuttle back to Hotel – Pick up in front of BH (~1600)