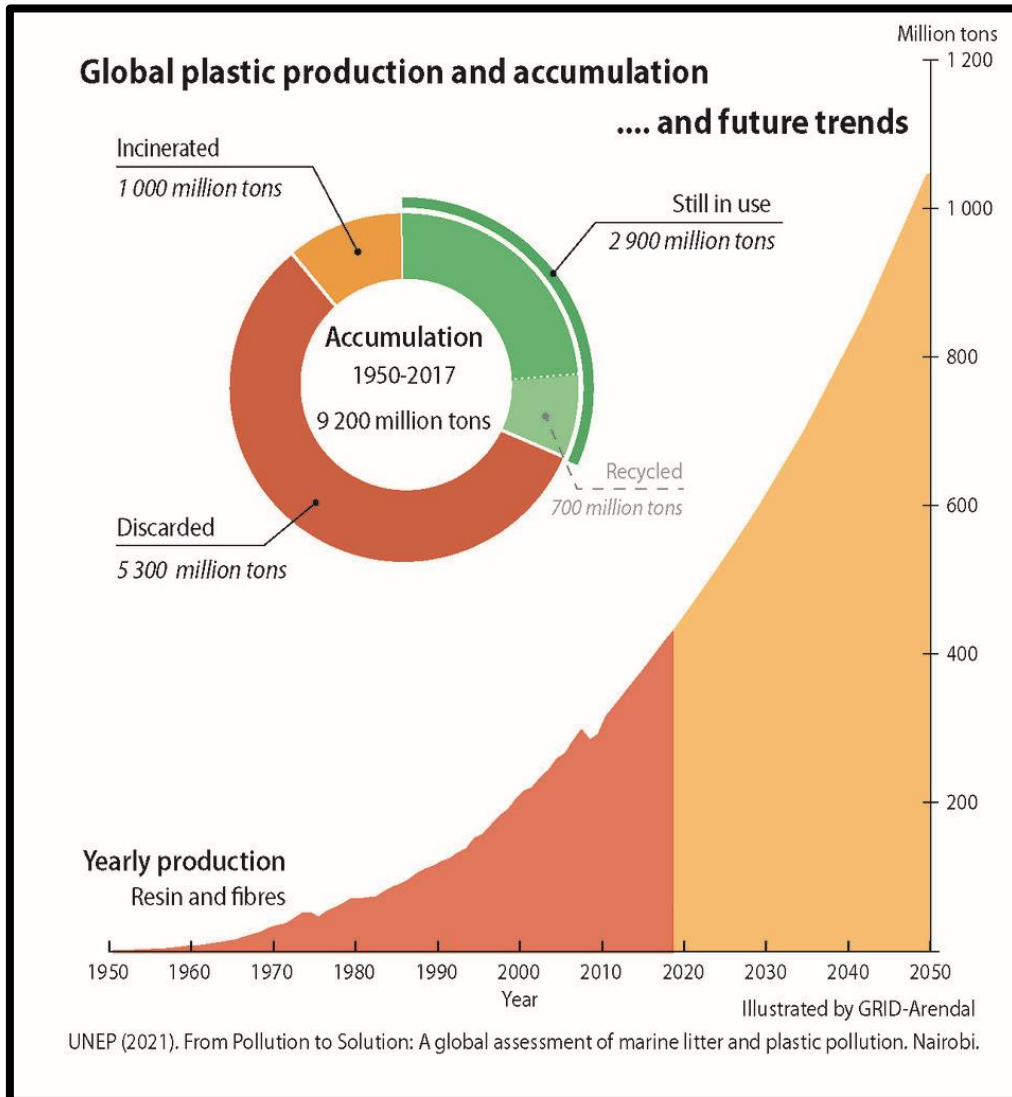


Student Startups. A Problem-Based Learning Approach to Teaching Sustainable Chemistry

Ms. Buse Sonmez and Dr David Palomas, Department of Chemistry
ESD Network Show & Tell

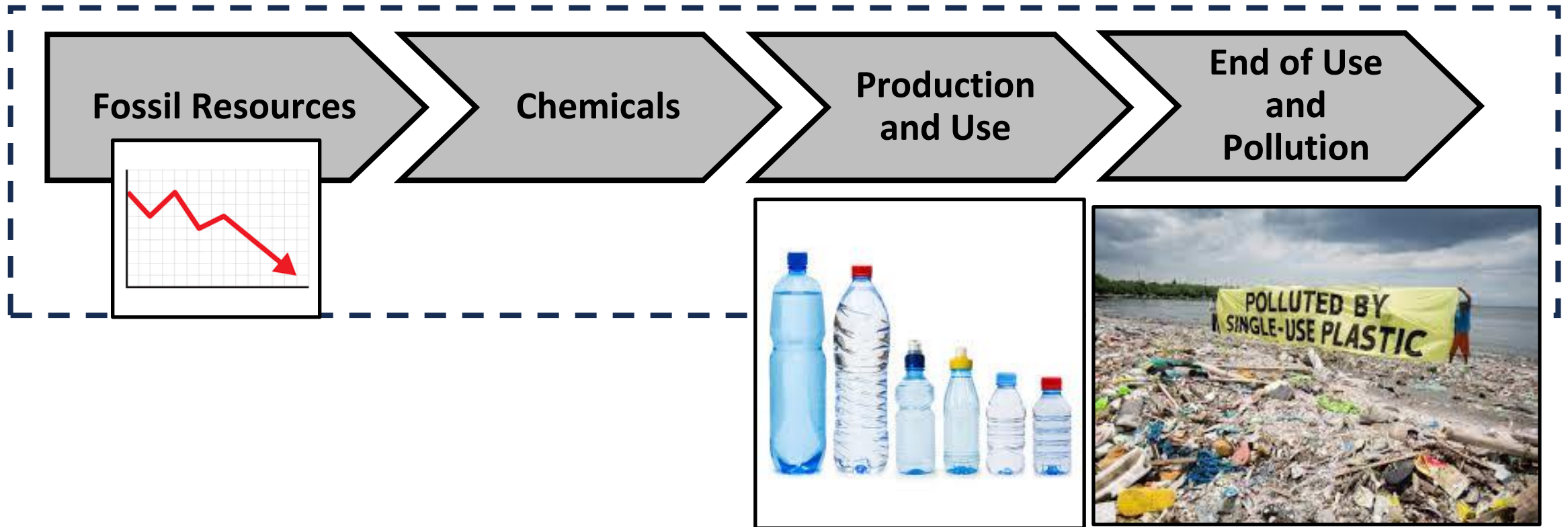
The Global Challenge of Plastic Recycling



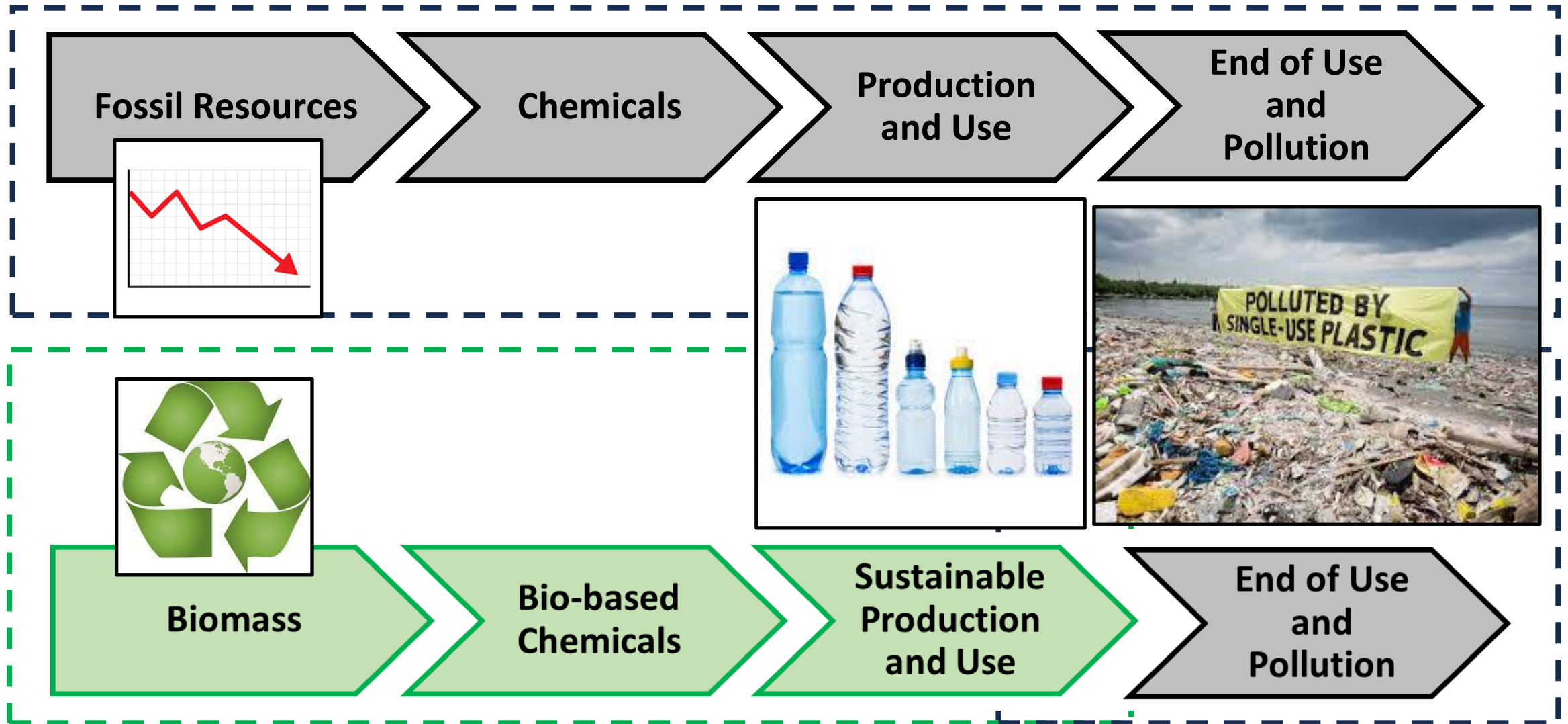
- In the early 2000s, the amount of plastic waste we generated rose more in a single decade than it had in the previous 40 years.
- Today, we produce about 400 million tonnes of plastic waste every year.
- Global production of primary plastic is forecasted to reach 1,100 million tonnes by 2050
- Plastic waste — whether in a river, the ocean, or on land can persist in the environment for centuries
- **Less than 10 per cent of the wasted generated globally has been recycled**

Visual feature | *Beat plastic pollution*. (2022, March 1). UNEP - UN Environment Programme. <https://www.unep.org/interactives/beat-plastic-pollution/>

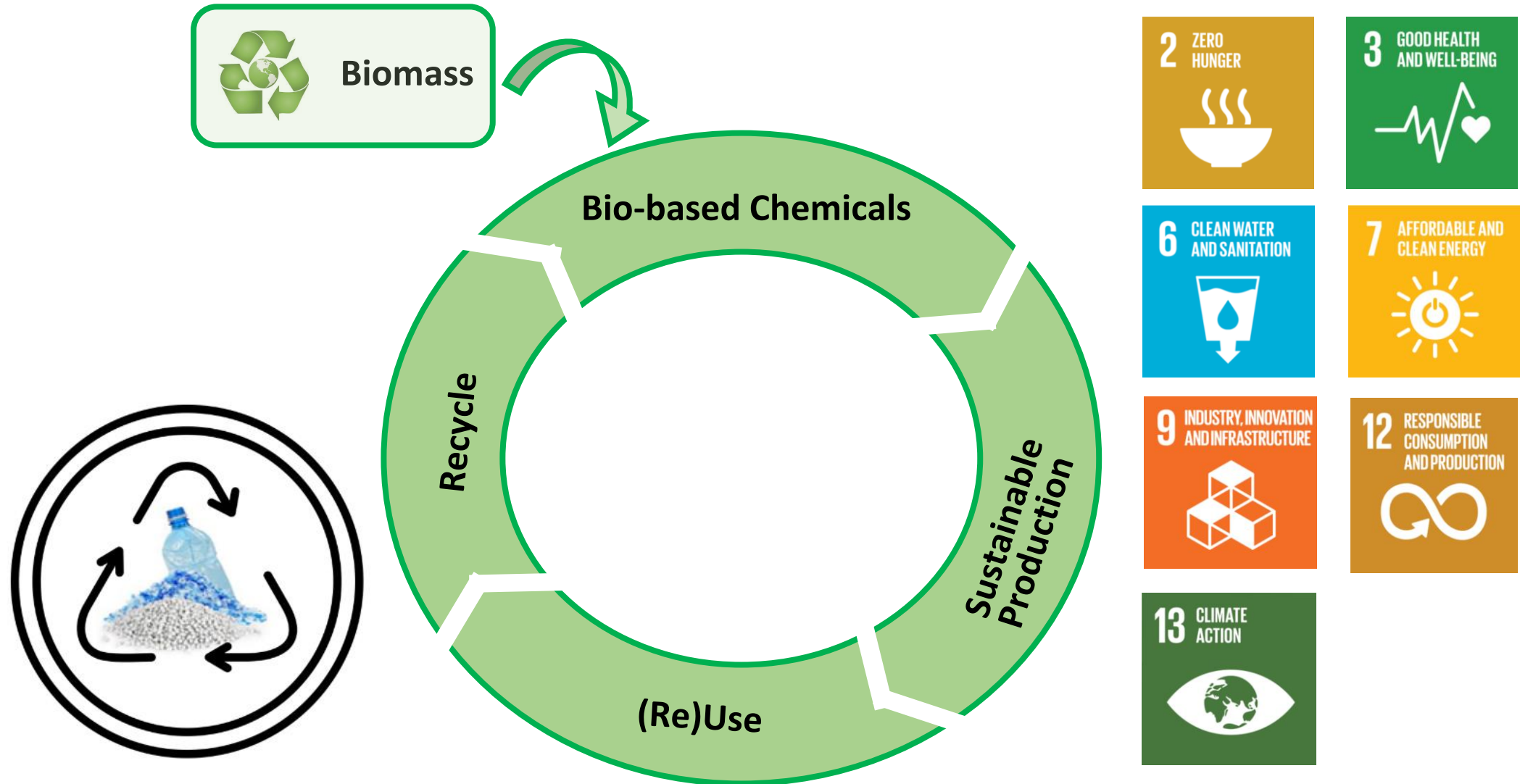
Teaching to Close the Sustainability Loop



Teaching to Close the Sustainability Loop



Teaching to Close the Sustainability Loop



What is Problem-Based Learning (PBL)?

Problem-based learning (PBL) is a student-centred approach to learning in which students work to solve open-ended problems in real-life scenarios

- Learning by the investigation, explanation, and resolution of problems, and reflection on the learning experience.
- Students work in collaborative groups
- The teacher is as a mentor and facilitator of the discussions, without interfering with the students' train of thought

Student Startups PBL Design

Context

- A real-world scenario in the chemical industry:
Production of PET plastics from fossil resources
- Activity objective:
Designing an approach to closing the loop in the sustainable production of PET plastics.

Participants' Roles

Based on real job postings:

CEO, CSO

Project Manager

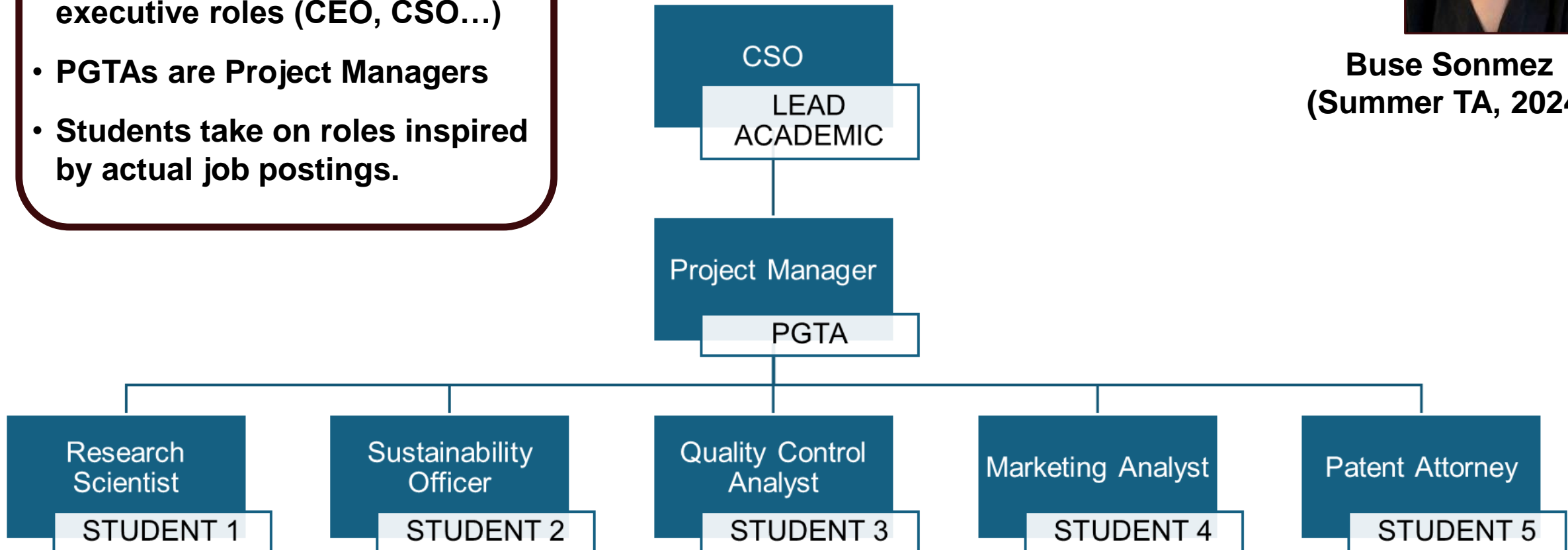
Research Scientist,
Sustainability officer, Quality
Control analyst, Marketing
Analyst, Patent Attorney

Model Startup Roles and Hierarchy

- Lead academics take on executive roles (CEO, CSO...)
- PGTAs are Project Managers
- Students take on roles inspired by actual job postings.



Buse Sonmez
(Summer TA, 2024)



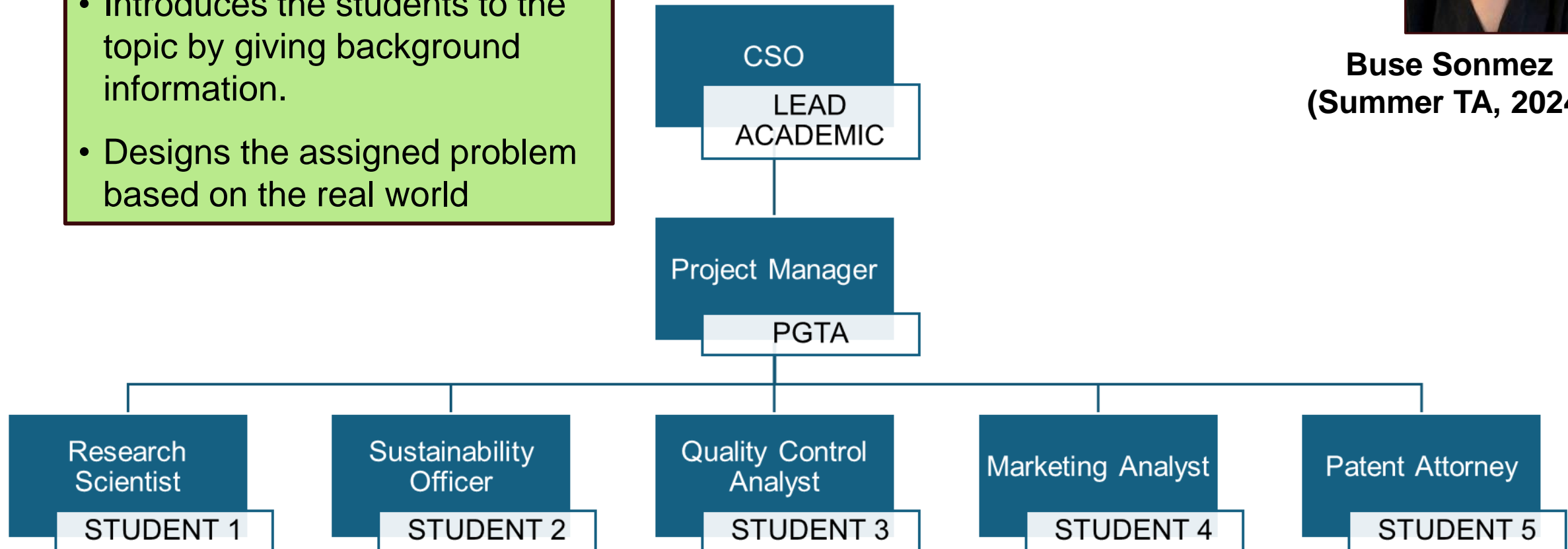
Model Startup Roles and Hierarchy



Buse Sonmez
(Summer TA, 2024)

CEO, CSO (Lead Academic)

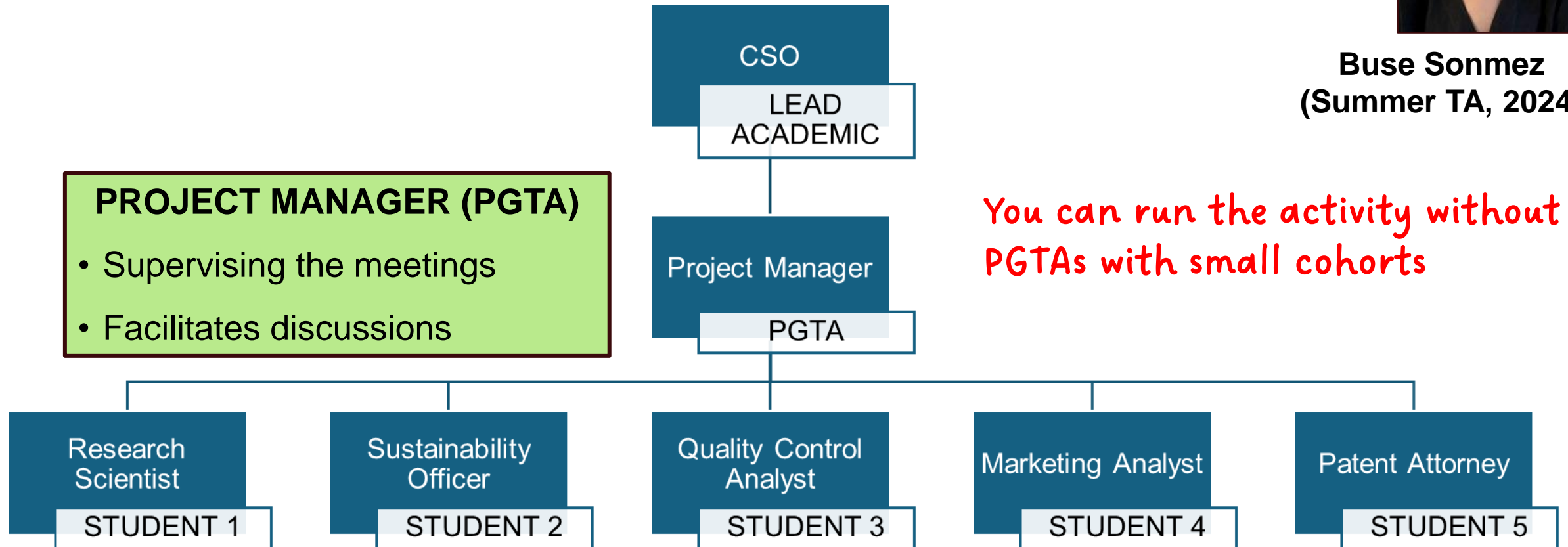
- Introduces the students to the topic by giving background information.
- Designs the assigned problem based on the real world



Model Startup Roles and Hierarchy



Buse Sonmez
(Summer TA, 2024)



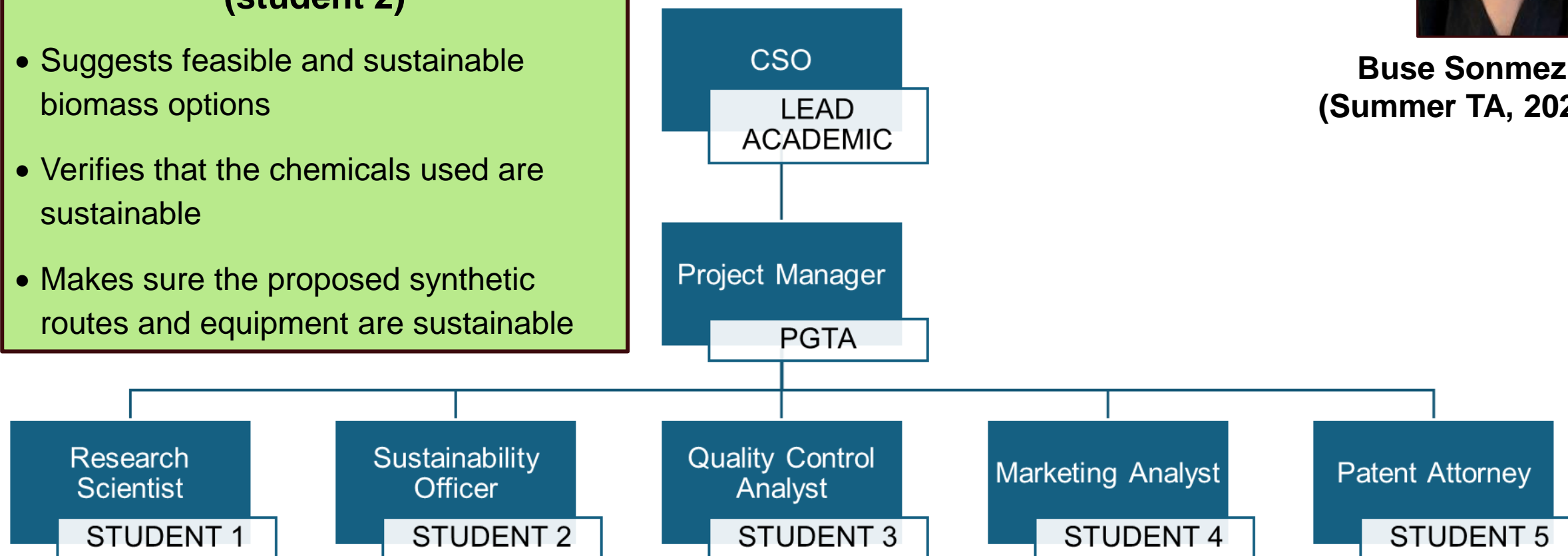
Model Startup Roles and Hierarchy



Buse Sonmez
(Summer TA, 2024)

SUSTAINABILITY OFFICER (student 2)

- Suggests feasible and sustainable biomass options
- Verifies that the chemicals used are sustainable
- Makes sure the proposed synthetic routes and equipment are sustainable



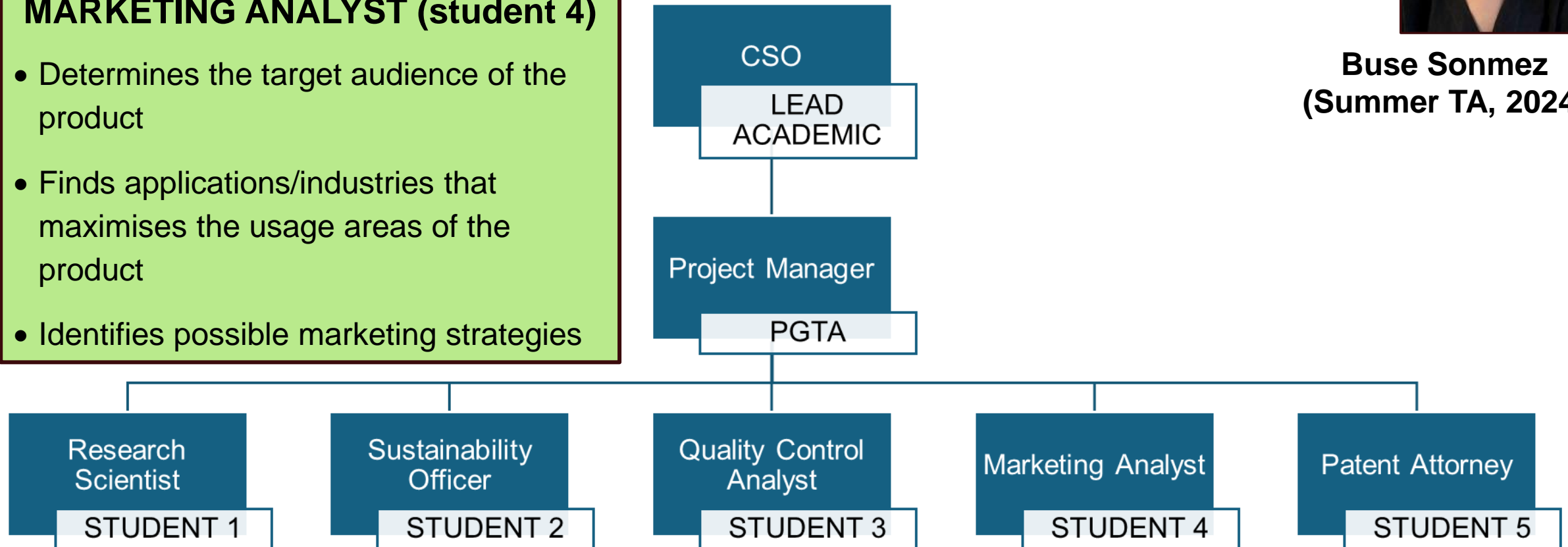
Model Startup Roles and Hierarchy



Buse Sonmez
(Summer TA, 2024)

MARKETING ANALYST (student 4)

- Determines the target audience of the product
- Finds applications/industries that maximises the usage areas of the product
- Identifies possible marketing strategies



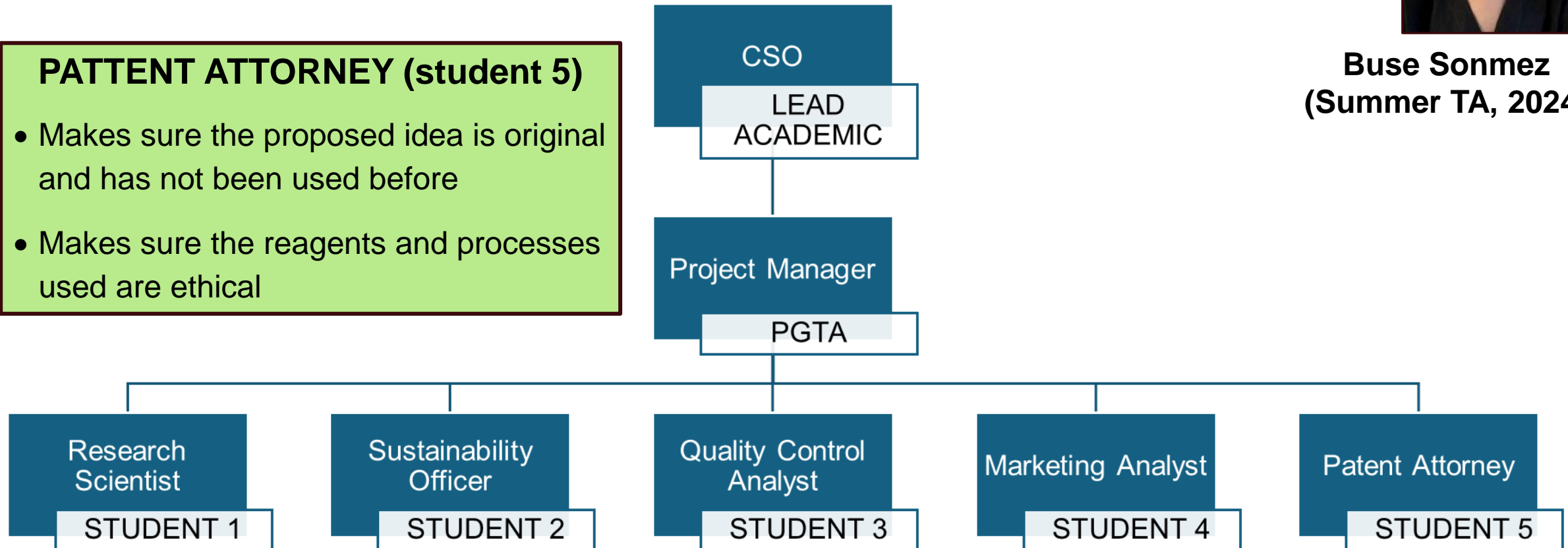
Model Startup Roles and Hierarchy



Buse Sonmez
(Summer TA, 2024)

PATTENT ATTORNEY (student 5)

- Makes sure the proposed idea is original and has not been used before
- Makes sure the reagents and processes used are ethical



Timeline and Structure of the Student Startups PBL activity

- Module CHEM0087: Core Concepts in Chemical Sustainability
- 8 international students
- 3 weekly 2-hour worth sets of educational materials (recorded lectures, readings and quizzes)
- Kick off lecture (1h)
- 3 weekly 2-hour workshops (active learning sessions)

WEEK	ACTIVITY	COMMENTS
0	On-line Educational Materials available	The activity is flipped, and the active learning sessions from week 2 are PBL workshops
1	Kick off lecture	<ul style="list-style-type: none"> • Chiel Scientific Officer (CSO, Lead Academic) introduces real-life industry problem in the context of sustainable chemistry. E.g. Sustainable production of PET • Students form groups (startup companies) and are assigned to a PGTA (Project Manager)
2	Workshop 1. Biomass Pre-treatment	First company meeting overseen by Project Manager to work on workshop 1.
3	Workshop 2. Design of Sustainable Chemical Processes	Second company meeting overseen by Project Manager to work on workshop 2.
4	Workshop 3. Design of Recycling Protocols	Third company meeting overseen by Project Manager to work on workshop 3.
5	Q&A Session	Feedback provided by CSO
6	Submission of Assessment and presentation of results to CSO	Example of Assessments include poster presentation, report submission and oral presentation to a panel of academics (e.g. pitch to a group of “investors”)

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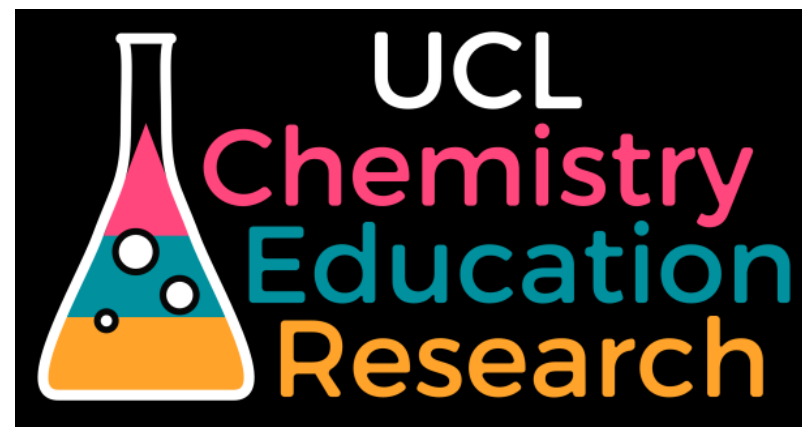
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Take-Home Notes

- The startup-simulated PBL model is adaptable across different disciplines, not only sustainable chemistry.
- Preliminary feedback indicates that students:
 1. Enjoy a Problem-Based Learning approach in the course
 2. Feel more confident to apply their knowledge in sustainable chemistry to real-world industry problems.
 3. Appreciate the opportunity to explore and understand diverse career options in sustainable chemistry.

Thanks for your kind attention!



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