Putting Course Design Principles to Practice: Creation of an Elective on Vaccines and Immunoengineering

Prof. Joshua A Enszer, University of Delaware

Joshua Enszer is an associate professor in Chemical and Biomolecular Engineering at the University of Delaware. He has taught core and elective courses across the curriculum, from introduction to engineering science and material and energy balances to process control, capstone design, and mathematical modeling of chemical and environmental systems. His research interests include technology and learning in various incarnations: electronic portfolios as a means for assessment and professional development, implementation of computational tools across the chemical engineering curriculum, and game-based learning.

Prof. Catherine A Fromen, University of Delaware

Catherine Fromen is an Assistant Professor in the Department of Chemical and Biomolecular Engineering at the University of Delaware. She received her PhD in Chemical Engineering from North Carolina State University in 2014 and performed postdoctoral studies at the University of Michigan as a University of Michigan's President's Postdoctoral Fellow. She joined the University of Delaware in 2017, where her research group focuses on applying chemical engineering principles to pulmonary drug delivery. Major research efforts in the group involve designing polymeric, degradable therapeutic pulmonary aerosols for immune engineering and creating 3D-printed lung replicas to advance in vitro deposition testing.

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Abstract

At our university, most assistant professors are expected to develop and deliver a new senior/graduate-level elective course related to their research. We present here a collaboration between a non-tenure-track, teaching-focused associate professor (Professor A) and a new tenure-track assistant professor (Professor B) to design a course using principles from the literature. With the goal to generate new learning experiences at the graduate elective level, a course on "Vaccines and Immunoengineering" was developed via principles of backwards design, significant learning experiences, and team-based learning. In the months leading up to the delivery of the course, we met regularly to review educational literature and implement findings in the development of the rubric, topic outline, and class activities.

To design the structure of the course, first a list of course learning goals was developed. Bloom's taxonomy in the cognitive domain was used as the primary guideline to ensure that different levels of learning were incorporated and that learning goals were measurable. Fink's taxonomy of significant learning was used to add additional goals in the affective domain. This systematic course design approach was found by Professor B to be not only straightforward, but empowered her to design a course focused on integrating significant learning experiences *a priori*, rather than as an afterthought (an extra burden).

Approximately two months before the course began, the professors discovered that the course was overenrolled due to an error in our university's scheduling system. To compensate for the fact that nearly 40 students (roughly half the size of the entire senior undergraduate class) were registered for the first offering of this elective, with no graduate teaching assistant support, principles of team-based learning were applied. The major projects of the course were completed in groups, but to hold individuals accountable, every student wrote a weekly reflection on their personal progress and learning. At the end of the semester, in lieu of a final exam, each student submitted a 10-15 page learning portfolio in which they wrote a narrative and included curated examples of the work they completed during the term. Each assessed element of the course was directly mapped to one of the course learning goals explicitly on the syllabus.

In this paper, we provide key assignment and assessment documentation associated with the course and discuss how these elements connect to the literature on education. In next offering of the course, the pace of the course will be adjusted and more guidance will be provided on reading assignments.

Background

There have been several articles written to state the obvious: that assistant professors rarely enter their positions with sufficient training in all elements of being a faculty member [1] [2] [3]. There are several resources available to provide advice to assistant professors, as well as for teaching courses, whether for the first time or for redesigning an existing course [4] [5] [6]. With such a variety of resources available, and many of them providing tips for spending the time used to prepare to teach as efficiently as possible, it can be overwhelming for new assistant professors to find the resources that work best for them.

Over the past ten years, the number of tenure-track faculty members in chemical engineering programs has grown by about 15%, from 1837 in 2009 [7] to 2114 in 2018 [8]. It is harder to track the proliferation of non-tenure-track positions in chemical engineering, though by one accounting, the number of permanent non-tenure track faculty across all engineering disciplines has nearly doubled in this time [9]. Most non-tenure-track faculty are hired to focus on teaching, and some universities deliberately connect these teaching faculty with incoming tenure-track faculty to set them with teaching resources early in their career [10] [11].

The goal of this work is to describe a specific grassroots collaboration between a non-tenure-track associate professor (Professor A) and a tenure-track assistant professor (Professor B) to design a new senior/graduate split-level elective course to be delivered by Professor B for the chemical engineering program at the University of Delaware. Professor B has a nominal teaching workload of 25% of time spent (65% research, 10% service), while Professor A's nominal teaching workload is 75% (10% research, 15% service). At this institution, while there are several resources for both formal and informal mentoring, there are no established programs or formalized culture to promote this specific teaching collaboration.

Professor B designed the course to be delivered for the first time in her fourth semester at the University of Delaware. Prior to this course, she had experience delivering a core course in the chemical engineering program twice in the previous three semesters, including the immediately prior Fall 2018 semester. Professor A had held a teaching-focused faculty position for the previous eight years, teaching on average three course per semester in that time.

We hope that by describing our process that we can present one way faculty at other institutions can begin more formal teaching collaborations, as well as provide advice for future iterations of this process at our own institution.

Methods

At the University of Delaware, teaching schedules for upcoming semesters are established around the start of the previous semester; therefore, the days and times of a new upcoming chemical engineering elective were determined in September 2018, roughly five months before the start of the Spring 2019 semester. Serious efforts in planning for the elective course began four months before the start of the spring semester, with Professor B largely focused on content choices and overwhelmed with the process of mapping that onto a semester. Roughly three months before the course began, the faculty met to discuss general course design and decide what resources may be most practical to help form the structure and organization of the course. In this one-hour meeting, the faculty discussed principles of backward design and learning objectives.

One of the quintessential discussions of backward design comes from Wiggins and McTighe [12], who spell out the idea in three simple stages: (1) identify what students should be able to do by the end of the course; (2) determine the necessary evidence to tell whether or not a student has achieved those results; and (3) plan the instructional activities needed to help students make this happen. They further provide detailed templates, as well as several detailed chapters, to expand upon these three stages.

Implementing backward design is difficult without sufficient training and reflection on specific learning objectives. To this end, the faculty discussed two main taxonomies of learning: Bloom's revised taxonomy for the cognitive domain [13], as well as Fink's taxonomy of significant learning [14]. As a cognitive taxonomy, Bloom's focuses on mental skills or knowledge. In order of complexity, the modes of knowing are (1) remembering, (2) understanding, (3) applying, (4) analyzing, (5) evaluating, and (6) creating. There are several resources available to help educators design learning objectives that are both specific and measurable, using Bloom's taxonomy as a framework. Fink defines his taxonomy of significant learning in terms of the change we wish to see in our students as a result of their learning, and therefore the categories include more than cognitive skills. He also argues that these six categories are not hierarchical, but rather relational: (1) foundational knowledge, (2) application, (3) integration, (4) human dimension, (5) caring, and (6) learning how to learn. To be clear, Fink's taxonomy of significant learning does not have a rank order; we number the items here to make clear how they were applied in course design. We also note there is a rough mapping of Fink's first two categories to Bloom's revised taxonomy: foundational knowledge comprises of remembering and understanding; application includes both analyzing and applying.

After allowing about three weeks for Professor B to focus on learning objectives, the pair met to discuss how to structure the course and its policies to support student attainment of these objectives. The second one-hour meeting consisted primarily of discussing assignments and assessment. Again, there are a number of references available to discuss assessment of student work [15] [16].

At this time, course enrollment began, and due to a miscommunication associated with combined sections (allowing separate enrollments for undergraduate and graduate students), the number of students registered for the new elective was double the intended maximum for the course. Therefore, in discussing assessments, some emphasis was given to team-based and problem-based pedagogies that would create significant student learning experiences while minimizing Professor B's implementation and grading burden. Given their review of the Fink text, learning portfolios were one major item of discussion. A learning portfolio requires a student to assemble a document at the end of the semester, based on progress made during the semester, to show their personal attainment of learning outcomes. Such a portfolio allows the instructor to focus more on formative feedback on weekly assignments, knowing students will have opportunities to select and revise representative work associated with given learning outcomes. Team-based learning (TBL) was briefly considered, and Professor B was put in touch with other experts on those methods at our university [17]. Some ideas related to this pedagogy were adapted for this elective course, but the formal TBL approach was not adopted.

Part of Professor B's motivation in pursing this collaboration was concern that being the sole instructor for a new elective would monopolize her time. To assess the potential impact of this collaboration on Professor B's teaching and overall work efficiency, a retroactive evaluation was performed on her daily time tracker. Professor B independently kept a real-time log of her various work activities using a free online tracker Toggl [18] in both Fall 2018 and Spring 2019. Using this tool in both semesters, she logged individual activities in real-time each day, grouping each activity as one of 4 projects: Research, Teaching, Service, and Logistics. As the Logistics category mainly comprised of uncategorized time responding to emails, this was removed in the subsequent analysis. Each activity was also given more detailed labels, including “Lecture Prep”, “Class Lecture”, “Grant Writing”, “Student Time”, etc., enabling a detailed retroactive analysis. Based on complete available log entries that enabled a direct comparison between the two semesters, the fourth and fifth weeks of both semesters were analyzed. In Fall 2018, Professor B taught a junior level core undergraduate course, which was her second time teaching the course. In Spring 2019, she taught the Vaccine and ImmunoEngineering elective for the first time. Professor A did not keep a log of time, but was involved only in planning, not in implementation of the course itself.

Results and Discussion

The final version of syllabus, reflecting the completed course, is shared in the Appendix. Additional documents of the first activity prompt (Problem Based Learning) and the second activity class-sourced rubric for peer evaluation and are also shared in the Appendix. We discuss here key elements related to the planning and implementation of the first iteration of the course.

Following the principles of backwards design, Professor B identified 10 “Key Learning Goals” for this first iteration of the Vaccine and ImmunoEngineering elective, as shown in Table 1. The list of goals reflects virtually all elements of Bloom’s and Fink’s taxonomies in some part. Professor B went through multiple drafts of these learning goals with the assistance of Professor A, beginning in late December with a viable working draft, and finalizing them two weeks prior to the start of the course, as they were refined with later planning exercises.

Table 1. Learning goals listed on final syllabus. The goals and assessments were provided to the students. The third column was added to reflect the considerations of learning taxonomies that went into creating this list. Note, we omit Fink's first two taxonomy categories based on their mapping to Bloom's taxonomy.

Key Learning Goals	**Assessment**	**Taxonomy Category**
1. Defend a position on public vaccination to a lay audience by summarizing historical and scientific context	1	Bloom 5, Fink 4
2. Explain an overview of the key innate and adaptive immune components. Identify key cell, biological systems and their location in the body.	2	Bloom 1, 2, 3
3. Compare current types of vaccine technologies & routes of administration	2	Bloom 2
4. Interpret trends and identify challenges in manufacturing and regulation of vaccines and biologics	2	Bloom 1, 2
5. Differentiate methods of action and optimized physiochemical attributes of small molecule, biologic, and particulate immune modulators	2,3	Bloom 2
6. Identify sources of information and critique medical, pharmaceutical, and scientific literature related to immune engineering	3	Bloom 3, Fink 6
7. Design a novel vaccine/immune engineering approach for an emerging or untreated condition	3	Bloom 6
8. Generate skills (and products) to successfully distill and communicate difficult scientific and biological topics to a lay audience	1-4	Fink 4, 5
9. Connect core chemical engineering principles to issues in human health	3,4	Bloom 4, Fink 3
10. Value the role of scientific pioneers, chemical engineers, and scientific advocates in tackling issues of human health	1,4	Fink 4, 5, 6

Once a working draft of the learning objectives were established and discussed with Professor A, specific assessments were assigned for each of the learning objectives (Table 2). At this time, assessments were mapped directly to the learning objectives as shown in Table 1. The majority of the graded assessments were designed as team-based activities, supplemented with writing components (weekly writing reflections and a capstone Learning Portfolio) as described by Fink. All assessments were chosen to directly measure attainment of learning goals while allowing the instructor to strike a balance between low-stakes, formative assessment, and assignment of grades.

Table 2. Assessment schedule for student work. The five items were weighted equally.

	Assessment	**Description**	**Due Date**
1	Team Activity 1	Historical vaccine evaluation debate	2/25 in class
2	Team Activity 2	Interactive vaccine presentation	3/27 in class
3	Team Activity 3	Immune engineering solution presentation	5/8-5/20 in class
4	Learning Portfolio	(Described in detail below)	5/20 online
5	Participation	In class quizzes, written reflections	weekly

The bulk of the course involved three distinct team activities. Prior to the semester, all three activities were planned, including logistics of team formation (new groups were assigned for each activity), specific team output parameters, due dates, and evaluation metrics (including instructor-, self-, and peer- evaluations). Best practices for team activities and outcomes were implemented with guidance from Professor A, using CATME evaluation surveys [19] and establishing a group contract prior to each activity. Significant lecture time was used towards preparing the group projects, which enabled greater buy-in from students with varied schedules to participate in team activities.

The first activity adapted a Problem Based Learning approach, where students were given a hypothetical scenario that required them to identify the type of information they would need about a sub-set of historical vaccines, perform their own independent research, and report back to their team. Activity 1 culminated in a class-wide debate, where students leveraged their independent research to make compelling arguments to their peers, achieving Learning Outcomes 1, 8 and 10. This was a memorable experience for most students, with many student evaluation comments focusing on the utility of this exercise to understand alternative viewpoints to vaccines and how to convey the utility of vaccination.

The second activity focused on digesting complicated fundamentals of immunology, which is well beyond the scope of a typical chemical engineering student’s background, albeit necessary to understand modern day vaccines. In smaller teams, students in Activity 2 had to make an interactive display that taught a non-scientist about the immune system in the context of disease. Activity 2 culminated in a sharing exposition in class, where each team assessed the accuracy of the content and the accessibility of the display, achieving Learning Outcomes 2-5 and 8. This open-ended activity allowed students to demonstrate significant creativity; sample work is depicted in Figure 1.

Figure 1. Four representative Activity 2 group projects describing the immune system. Top left, computer game "Mr. Bones" where users play as different cells and have to respond appropriately to a vaccine or pathogen. Top right, "Dr. Google" where users can directly ask Dr. Google a question about the immune system and hear recorded videos from student "experts". Bottom row, two example interactive Prezis [20].

In Activity 3, student teams chose an emerging pathogen and performed an in-depth literature search to assess current vaccine approaches. They then had to apply their knowledge of immunology and immune engineering to propose an entirely new system that would advance the vaccine design. Students presented these in a 15-minute scientific oral presentation, with 10 minutes of questions and answers from the rest of the class to promote a discussion and peer assessment. Activity 3 achieved Learning Outcomes 5-8.

The two writing components worked to maintain student accountability throughout the semester and engagement with course material outside of the lecture. Each week, students were prompted to respond to five questions:

(1) What did you learn about the subject this week? (What is still confusing?)
(2) How does this fit into the larger context of your individual life, your social/organizational life, and/or work life (especially connections to your chemical engineering education)?
(3) How did you engage with course materials outside of the class period?
(4) Did you communicate your learnings to someone not in the class? Did you relate your learnings to any current events?
(5) What did you learn about how you learn (or how you could learn) more effectively?

A simple 3-point grading rubric to evaluate the weekly writing reflections was established at the beginning of the semester with input from the class. The agreed-upon rubric is shown in Table 3. This regular assignment prompted students to discuss course topics and how they relate to current events with their peers, as well as regularly assess their own engagement in the course. The simple grading approach allowed students to feel comfortable being candid in their responses about how well they were keeping up with the material and whether they were living up to the course expectations. For a class with a large fraction of second semester senior undergraduates, this was a powerful check that helped keep their engagement strong (and combated "senioritis") throughout the semester. These writing reflections also were a valuable resource for Professor B. She not only was able to gauge the progress of the class and adjust the pace accordingly, but by hearing directly from every student in the course, strengthened connections with individual students who felt their voice was being heard. Furthermore, hearing how students engaged with the materials – from pursuing their own research, to raising unanswered questions, to discussing with peers and family members – and assessed their own learning successes and failures, was often inspirational to Professor B, which helped maintain her own engagement with the course throughout the semester. The large benefit came with only a small time investment; writing reflections of all 38 students could be easily graded in under an hour.

Table 3. Rubric for writing reflections. The five questions are listed above.

1 point	2 points	3 points
• Numerous grammatical or technical errors • Addresses first prompt only	• Addresses first prompt and at least one other prompt • Free of glaring grammatical & technical errors • Expresses a coherent thought	• Engagement with material goes above & beyond class expectations • Addresses first prompt and multiple other prompts

The capstone learning portfolio also proved to be a valuable exercise in metacognition, requiring students to directly reflect on what they learned and what they believe they will retain. Students were required to create a two-page summary statement and then assemble 10-15 pieces of "evidence" from the course that demonstrated their learning. Similar to the weekly writing assessments, these were both beneficial to the student in solidifying their knowledge and to Professor B in appreciating the significant learning accomplishments.

As a final confirmation of the significant learning achievements, the final course lecture involved a Kahoot game [21] to test student knowledge retention, with a small prize given to the top students. Students were incredibly engaged and motivated to participate, ending in the most rewarding moment of the course. During a break part way through the game, the instructor heard one student exclaim, "I can't believe how much I learned in this class!".

Professor A was instrumental in guiding the framework of this course and helping Professor B to improve her time management. To assess this improvement, retroactive assessment of the breakdown of a representative 2-week period in the middle of the semester is shown in Figure 2. Here, we see that Professor B worked a total of 128 hrs (~64 hrs/week) over this period in Fall 2018, which was significantly decreased in Spring 2019 to 83 hrs (~42 hrs/week). Professor B's effort should align with 65% research, 25% teaching, and 10% service, which is not too far from this sampling of Fall 2018. However, in Spring 2019, we see an increase in service (related to the Professor B serving on a faculty hiring committee that semester), which resulted in a drop in percentage of teaching time. This was somewhat counter to Professor B's expectations heading into Spring 2019, where she expected the new course to significantly monopolize her time. If anything, the decrease in overall teaching time points to significant benefits to this collaborative planning effort. While we cannot rule out slight variations in the assistant professor's Toggl diligence between these two semesters that may account for the total hours clocked, this overall decrease in total work hours across the two semesters without decreases in productivity suggests that some improvements in time management were broadly achieved for the semester.

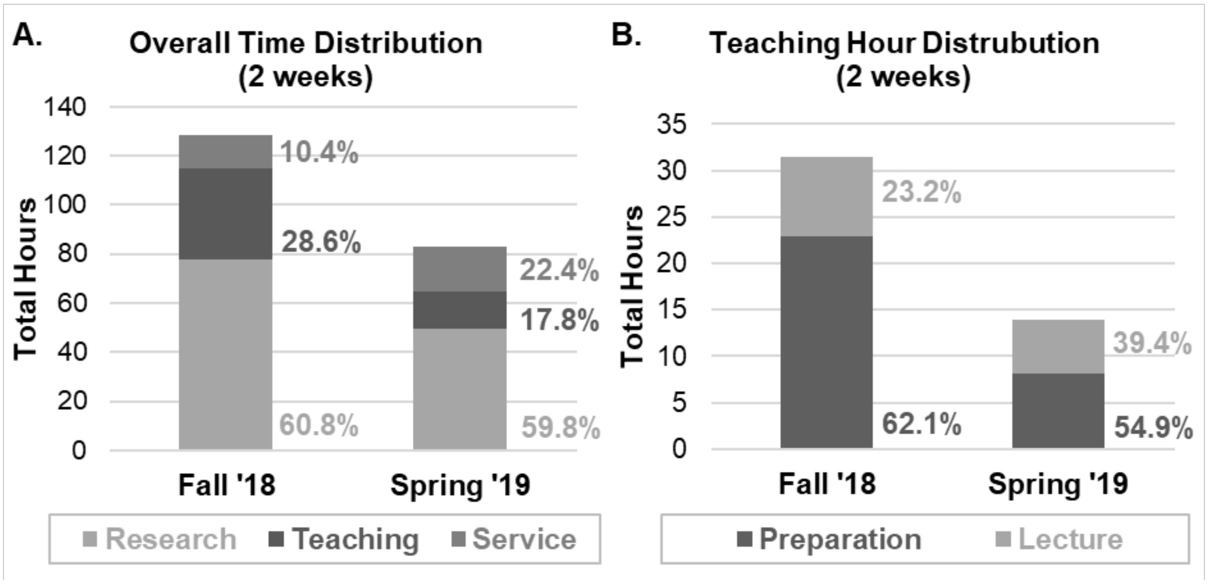

Figure 2. Distribution of Professor B's time. A) Total working hours during the representative two weeks, with the corresponding percentage of total working hours shown. B) Hours devoted to class preparation and in class lecture time, with the corresponding percentage of total teaching hours shown. (out of class student time and office hours not shown).

More direct improvements in Professor B's teaching efficiency can be observed in Figure 2B. In Fall 2018, she spent a total of 30 hours on teaching her core course (~38% assuming a 40 hr "normal" work week), with over 62% of that time involved in lecture preparation. This corresponds to 2.67 hrs of preparation for every hour of lecture, which is high, but consistent with findings related to assistant professors early in their teaching careers [1]. However, in Spring 2019, Professor B clocked just under 15 hrs of teaching time over the 2 week period (~18% assuming a 40 hr "normal" work week). Importantly only 55% of that time was spent in lecture preparation, corresponding to 1.4 hrs of preparation for every hour of lecture. These are meaningful decreases to Professor B's weekly teaching time, again directly suggesting adequate course planning prior to the semester that did not require significant alterations a month into the course. Of note, 13.9 hrs were devoted to the course design and prep in the 2 weeks immediately prior to the start of the semester.

Professor A was only involved in framing some of the planning conversations associated with the design of this course, with no time devoted to its implementation outside short, informal, and impromptu conversations during the semester. The amount of time spent preparing and participating in planning meetings before the start of the Spring 2019 semester was no more than 8-10 hours in total.

Overall, the first version of this course was largely successful. Student evaluations were overall quite positive, with 100% agreeing or strongly agreeing that the course added to their understanding of the impact of engineering solutions on society and that the course made them demonstrate their ability to communicate, and 96% saying the course "frequently" or "almost always" required them to communicate effectively and engage in contemporary issues. Evaluations of the Learning Portfolios demonstrated that all students in the course achieved proficiency in each course learning goal. However, there are a number of minor improvements that will be made in future iterations of the course. Overall, Professor B felt that she struggled to correctly balance the pace of the course; Activity 2 was given too much time to accomplish, while Activities 1 and 3 did not have enough time. Surprisingly, students overwhelmingly expressed a desire to have graded exams, rather than participation-only grades. These comments were received in the course evaluations, weekly writing prompts later in the semester, and the capstone Learning Portfolio, where students expressed that graded quizzes would enforce their reading habits. The course will be offered again in Spring 2020, and the two major changes will be the rebalancing of the activity distribution, updating the rubrics for activities, and adjusting the grade distribution to account for graded quizzes. Furthermore, the assistant professor aims to translate Activity 2 efforts to scientific outreach partners in the local area, targeting middle school science students.

Conclusions and Recommendations

We provided here a sampling of the literature on professional development for assistant professors, including references to texts that we have found practical and accessible in terms of implementing teaching and assessment strategies. The number of publications on these topics suggests that there is no one-size-fits-all method to for faculty to design new courses, though there are certainly commonalities in terms of establishing clear learning objectives and thinking critical and reflectively to ensure there are opportunities for students to demonstrate their ability to attain this objectives. We shared the experiences of one collaboration between a teaching-focused non-tenure-track associate professor (Professor A) with a tenure-track assistant professor (Professor B). We believe this grassroots effort shows the viability and value of such collaborations. We encourage our colleagues in other programs and universities to engage in teaching mentorship and to document their efforts to share with others. This sort of mentorship should also count appropriately among the service workload of teaching-focused faculty. Finally, we have presented the result of this collaboration, via some key course documents specific to the course designed through this collaboration.

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Appendix: Course Syllabus

Vaccine and ImmunoEngineering CHEG 667-017/867-021

Department of Chemical and Biomolecular Engineering

University of Delaware - Spring 2019

Instructor: Catherine Fromen

Meeting: Alison Hall Room 133, MW 3:35 pm – 4:50 pm

Contact info: Catherine Fromen, Assistant Professor
Office: 209 Colburn
Email: cfromen@udel.edu
Office hours: Mon 9a- 11a and by appointment

Course Description: This course will instruct students in the application of biomolecular engineering principles to the design and assembly of vaccines and other immune engineering applications. It will cover an overview of historical vaccine development, process technologies, immunology for engineers, & literature assessments. Students will also discuss economics, ethics, & medical impact of vaccines and emerging immunotherapies on global human health. By the end of the course, students should be able to achieve the following 10 key learning goals (assessed through four learning assessments):

Key Learning Goals	Assessment
1. Defend a position on public vaccination to a lay audience by summarizing historical and scientific context	1
2. Explain an overview of the key innate and adaptive immune components. Identify key cell, biological systems and their location in the body.	2
3. Compare current types of vaccine technologies & routes of administration	2
4. Interpret trends and identify challenges in manufacturing and regulation of vaccines and biologics	2
5. Differentiate methods of action and optimized physiochemical attributes of small molecule, biologic, and particulate immune modulators	2,3
6. Identify sources of information and critique medical, pharmaceutical, and scientific literature related to immune engineering	3
7. Design a novel vaccine/immune engineering approach for an emerging or untreated condition	3
8. Generate skills (and products) to successfully distill and communicate difficult scientific and biological topics to a lay audience	1-4
9. Connect core chemical engineering principles to issues in human health	3,4
10. Value the role of scientific pioneers, chemical engineers, and scientific advocates in tackling issues of human health	1,4

Course Materials:

1. "How the Immune System Works (The How it Works Series) 5th Edition." Author: Lauren Sompayrac. ISBN-13: 978-1118997772 **older editions, pdf versions ok*
2. "Vaccine: The Controversial Story of Medicine's Greatest Lifesaver" Author: Arthur Allen. ISBN-13: 978-0393331561
3. Course website: Canvas https://udel.instructure.com/courses/1444095

Grading breakdown:

	Assessment type		*Due Date*	*Weight*
1	Team Activity 1	Historical vaccine evaluation debate	2/25 in class	20%
2	Team Activity 2	Interactive vaccine presentation	3/27 in class	20%
3	Team Activity 3	Immune engineering solution presentation	5/8-5/20 in class	20%
4	Learning Portfolio	*	5/20 online	20%*
5	Participation	In class quizzes, written reflections	weekly	20%

**800 level students will require an additional literature review (15%) in addition to the learning portfolio assessment (5%).*

Team activities:

This course will consist of 3 major team activities. Time will be designated during the class period to accomplish team-based activities. Grades for these activities will be broken down into group and individual scores, obtained following the guidelines established in the first day of class, and evaluated through a combination of instructor, peer-, and self-evaluations.

In class quizzes:

Periodic in class quizzes will occur throughout the semester to help gauge individual learning. While these will be graded for accuracy, they will count to the overall participation grade.

Written reflections:

Written reflections will be assigned weekly and must be submitted by 11:59 pm each Wednesday evening to Canvas. Reflections should answer the following:

- What did you learn about the subject this week?
- How does this fit into the larger context of your individual life, your social/organizational life, and/or work life (especially connections to your chemical engineering education)?
- How did you engage with course materials outside of the class period?
- Did you communicate your learnings to someone not in the class? Did you relate your learnings to any current events?
- What did you learn about how you learn (or how you could learn) more effectively?

Learning Portfolio

As a course capstone, individual learning portfolios (LP) will be submitted on the last day of class. These should consist of a 2-page narrative along with 10-15 pages of collated examples of your learning, detailing your learning accomplishments. This should be built throughout the course of the semester. Points to consider when preparing your LP:

- What are the most memorable and significant things you learned this semester?
- How does this fit into the larger context of your individual life, your social/organizational life, and/or work life?
- How does this connect to your chemical engineering education?
- How did you translate your knowledge outside of the course?
- How did you engage with others about your experience in the course?
- What did you learn about how you learn (or how you could learn) more effectively?

Academic Honesty:
All students must be honest and forthright in their academic studies. To falsify the results of one's research or homework, to steal the words or ideas of another, to cheat on an assignment or exam, or to allow or assist another to commit these acts corrupts the educational process. Any violation of this standard will be reported to the Office of Student Conduct. The default outcome for any student committing academic dishonesty will be failure of the course with the offense stated on the student's transcript. Some specific points:

- When you rely on the work of others (literature sources, textbooks, personal discussion, consultants) you must cite the sources accurately. This should include citations on any written statements, as well cited on each slide in a presentation
- When you present any research materials (data, documents or the writing of others) it must be done in a fair and honest fashion. You cannot selectively ignore information.
- Please refer to and follow the UD Code of Conduct found here: http://www1.udel.edu/stuguide/16-17/code.html#honesty

Class Guidelines:
The classroom is a welcoming space in which we all come together for learning. To ensure undisturbed instruction, use of electronic devices within the classroom will be limited to course activities. Please don't take phone calls, send texts, check email, watch videos... Follow the course contract established on the first day.

Class Schedule: **changes will be announced in class*

Class	Date	Section	Topic	Assignment for next class
1	2/11	Historical Vaccines	Course objectives, Syllabus overview, grading proposals, groups, pre-course test	Read Sompayrac Ch 1
2	2/13		A1	Read on specific A1 material – Allen chapters
3	2/18		A1	Construct A1 single slide on your main point
4	2/20		Snow day!	
5	2/25		A1	Refine single slide/ group presentation
6	2/27		A1 – In class presentation	Read Sompayrac Ch 2
7	3/4	Immunology & Vaccine Technologies	Introduce A2. Innate immunity	Read Sompayrac Ch 3&4
8	3/6		B Cells and Antibodies, Antigen presentation	Read Sompayrac Ch 5-6
9	3/11		T Cells	Read Sompayrac Ch 7-8
10	3/13		Secondary Lymphoid Organs	Read Sompayrac Ch 9-10
11	3/18		Tolerance Induction, Immunological Memory	Read Vaccine technology & adjuvant reviews
12	3/20		Vaccine technologies and Adjuvants	Read Route of administration & mucosal immunology reviews
13	3/25		Route of administration, Mucosal immunology	Read "Vaccine Process Technologies" and "Industrial Choices for

				Protein Production by Large Scale Cell Culture”
14	3/27		Vaccine process technology and analytics	Read Hep-A VAQTA papers and Enjoy spring break!
15	4/8		HepA VAQTA case study	
16	4/10		Commercialization timelines, clinical trials, regulations; Approved vaccines	Finalize A2; create 2 questions to test effectiveness of A2
17	4/15		A2 – In class presentation	Read Sompayrac Ch 14, CAR-T review
18	4/17	Emerging Engineering Technologies	Oncology and Immuno-Oncology, Immunotherapies, CAR-T	Read Moon/Irvine review
19	4/22		Nanoparticle immune therapeutics	
20	4/24		Introduce A3 How to critically read a paper	Read assigned primary article, A3 disease immunology & design
21	4/29		Primary lit critiques	
22	5/1		Primary lit critiques	
23	5/6		Primary lit critiques	
24	5/8		A3 – In class presentation – 3	
25	5/13		A3 – In class presentation – 3	
26	5/15		A3 – In class presentation – 3	
27	5/20		A3 – In class presentation – 3	