

## CMMB 545 Course Profile

The course description and Winter 2018 syllabus for Cellular, Molecular, Microbial Biology 545 (**Petroleum Microbiology**) can be [found here](#).

**Generally offered in:** Winter semester

**Prerequisite(s):** CMMB 343

**Antirequisite(s):** None

*Interview with Dr. Lisa Gieg*

### **In your own words, can you give a brief summary about what this course is about?**

This course, CMMB 545, is called petroleum microbiology, and it was devised as an optional course of interest more on the environmental microbiology side of things. It really **dives into the idea that microorganisms actually impact the oil and gas industry, which is something that most people don't know very much about**. When you think oil and gas, you often think engineering, but microorganisms can play a huge role, in both positive and environmentally-friendly ways to help produce oil more sustainably, but on the other side they can actually be very detrimental.

We focus on understanding the basics of geology, chemistry and microbiology. We have several lectures on four main topics:

- [1] Bioremediation, so when oil spills how can microorganisms help clean it up?
- [2] Enhanced oil recovery – how can microorganisms be used to generate petroleum and gas.
- [3] We also have a series on microbial corrosion of pipelines. Pipelines are a big issue nowadays, how can microbes possibly contribute to pipeline leaks, so that is a negative.
- [4] Then there is another phenomenon called “souring” and it devalues oil.

We also do some work on Alberta's oil sands industry, which is very important in this province. A lot of people hear about it in the news but don't necessarily know much about it and how microorganisms fit into that as well.

This course offers a broad overview of how microorganisms impact oil and gas in either a beneficial or detrimental way.

### **Going back to what you mentioned about souring, what is souring?**

Souring is caused by microorganisms that produce hydrogen sulfide as an end product of their metabolism. That's is sour – it is essentially a sour gas. So if you smell rotten eggs, that's H<sub>2</sub>S and there's a huge group of microorganisms that produce this. When it's produced, it's dissolved in the oil and makes it sour, which results in poor quality oil.

### **What is the main skill you want students to take away from this course?**

One of my hopes is that students become a lot more informed about the oil and gas industry in general and it provides another option for learning about where microorganisms are in the world and how they play a role in these different industries. What I would like is for students to be able to gather this information and when they go out and read an article about a particular issue in oil and gas that they understand it better. Also that they are able to communicate it and have a deeper understanding of this very important industry in our province and something that underlies a lot of global problems as well.

Another thing we do in the course every year is have a poster session. We ask groups of students to read a scientific paper and give a poster presentation on it. I think that's a very nice experience for students to practice science communication. What they do is they take what they've learnt in lecture and they have to go out and read a real science paper, which we think is a really high quality paper, and have to present it in class. It becomes a great opportunity to have a symposium within the classroom.

### **That is very cool. Is this poster session something that is done in the lab or within lectures?**

It's done in lecture. We actually don't have a lab for this course; it's all lecture based. We typically take a week near the end of the semester and have a little symposium. This is a good course for allowing students to practice their scientific presentation skills.

### **What aspect of the course do you think students struggle the most with?**

The first five lectures have no microbiology – **we don't cover microbiology for the first 2 weeks of class and some students are surprised by that.** In this time we cover what is oil, what are hydrocarbons, we make them draw structures, and we make them learn a little bit about oil reservoir geology and engineering. Most students struggle the most with this part.

**We also cover metabolic pathways:** how do microorganisms take a hydrocarbon and break it down? Most students are used to learning about glycolysis and learning about very simple pathways, but we teach them hydrocarbon specific pathways. I think most people are a little bit overwhelmed with those. In general, we have to do these things because when we're studying microbes in an oil patch we need to know what the microbes are doing. Learning about oil itself and how microbes use it as a carbon source for metabolism is very important, but is also the most difficult part of the course.

### **Besides attending lectures and doing the assigned readings, what can a student do to be successful in this course?**

**We do provide study questions,** but probably not too much outside of that. Talking to me about issues is fantastic and asking lots of questions. As an instructor, I really enjoy that because it means that I'm engaging the students. So I think that just talking a lot about issues and really engaging in the group work that's required for that poster assignment and discussing with fellow students I think really helps with understanding. I don't think there's really much else that they need to do.

### **About how many students are in the lectures?**

We generally have a cap of 60 students, and almost every year we are fairly close to the cap, so we generally have 50-60. This is maybe not one of your questions but I should also say that we offer this course as a graduate student course. So the graduate students have a slightly, what I would call more challenging assignment, but it's also an opportunity for new graduate students, especially those who are coming into our department, to work in environmental microbiology and it's a nice course option for them.

### **What are the main differences between the undergraduate and graduate versions of the class?**

As I mentioned, we have been doing the poster presentations with undergrads in groups. This also allows for group work, because in the real world you are rarely working by yourself and usually have to work in a group of people, whether you like them or not. You have to work together to meet a common goal and it allows for that.

But for the graduate students, what I've typically done is have them prepare a guest lecture on a topic that we don't cover in our lectures. It's something that's related, but not covered, like maybe a newer topic. I also make them write a term paper, so those are all done individually. To me, that is much more challenging, time-consuming and extra work.

### **In terms of the content, is it mostly the same and if someone took the undergraduate course, would they be able to take the graduate course?**

The content is exactly the same, so the graduate students take the examinations and such, it is mostly just the extra activity that we have built into the course which differs.

### **You've already touched on this, but are there any lab or tutorial components to this course?**

**No labs, just lectures.** It would be nice to have labs, but there are always budgetary and time constraints. At some point I would like to implement a field trip. That would be nice, but it requires a lot of logistics. That is something I have thought about and meeting the right people from my point of view that can lead a class of 60 onto a field-trip to an oil plant, pipeline or something related. The problem is that a lot of these oil sites require specialized safety training. Even I'm not to go out and help sample an oil well because I don't have the safety training. It is a liability issue, but there may be opportunities. I am always looking around for those kinds of options for the class. Sometimes we can describe something in class, but you learn a lot from just seeing – just visualizing “oh, this is what it's like.”

### **What resources (textbook, lecture slides, tutorial assignments, labs) should students focus on when preparing for the examinations?**

Generally, we don't have a textbook per-say, we have a couple of recommended books and always provide reference to additional reading, but really it's focusing on the content that is provided in the lecture slides. As I think I mentioned, we also provide study questions that guide students through the material. We do give a lot examples that the students don't have to memorize, but they are just provided

as examples. The study questions really help guide the students towards what they should be learning for the exams.

### Do you have any other advice for incoming students taking this class?

I think just having a general interest in environmental microbiology. Because it is an optional kind of course, just being as engaged and asking as many questions as you can. Thinking about and being interested in global problems. Energy and how humans get energy is a huge issue in the world. This really focuses on the petroleum side, but I think we need to keep an open mind. The other thing I want people to appreciate is in terms of microbiology; **most people learn about bad microorganisms, but there are far more good ones than harmful ones.** We make that point a fair bit that what we learn about in this course is organisms that contribute in a positive way.

### Do you have any funny memories or anything that has stuck out to you from your time teaching this course?

I don't know that there's been a lot of funny memories, I don't think I've screwed up anything that bad. I guess probably one of the most rewarding things that made me feel really good about the course was that a few years ago there was a student who was quite engaged in the course and asked a lot of questions. After reading week, he came back and said that "my dad is an engineer and he had a whole bunch of people over at the house and they were talking about an engineering problem and I could actually contribute! Because now I know something about this field." This made me feel really good; I'm glad that you're learning that now you can feel like you can contribute to conversations about this topic that you never could before.

I've had similar comments where students say, "**you've really opened my eyes and I'm able to understand more what's going on out there in the news.**" Those are the sorts of things that as an instructor make me feel really good.

Especially in Calgary, almost everyone has a parent, aunt, uncle, brother or sister or somebody that works in this industry and it just helps provide a bit more perspective around that. People generally appreciate it. I have had very few people who have strongly disliked the course; the comments are usually quite favourable.

*This interview transcript was edited for clarity and brevity.*