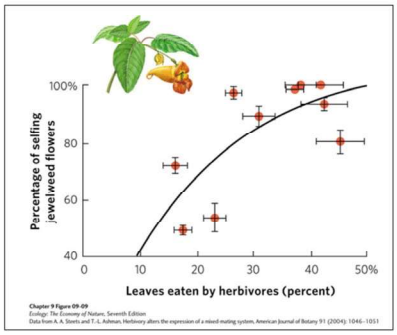
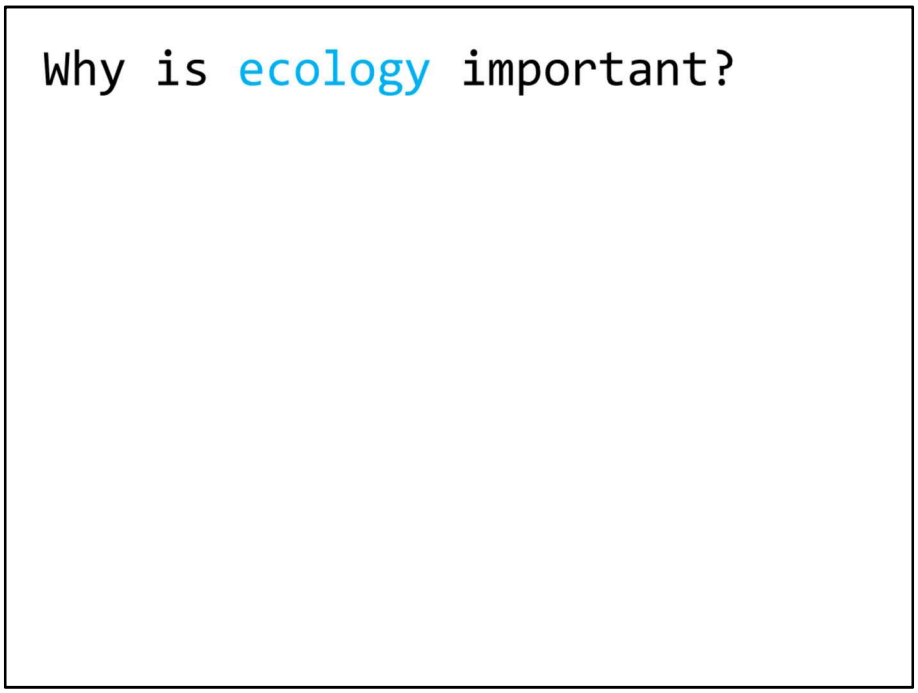
Grappling with problems: adventures in flipping the classroom to teach 3rd year ecology



SPARK 2023
Jenny McCune
Department of Biological Sciences

A grand challenge of teaching is to motivate students to engage actively with complex patterns, processes and theories – rather than just memorizing definitions. After their first two years in university, most biology students have mastered how to identify the correct answer from a list of choices, but many are not very good at explaining concepts in their own words, applying a theory to a new situation, or evaluating evidence. For the past four years, I have used the 'flipped classroom' idea to teach ecology at the third year level. Rather than listening to a lecture, the students spend most of the class time working together in small groups to answer problem sets made up of challenging questions based on assigned readings. I will share what I have learned about how to motivate students to do the assigned reading, facilitate collaborative group work, and respond to the discontented (e.g. "I don't learn well by reading", and "why can't you just lecture?"). While not all students are fans, many appreciate the chance to grapple with the sorts of questions they will see on exams. Taking this approach has been challenging – especially during the COVID-19 pandemic. However, watching the look on a students' face when they finally grasp a challenging concept, or overhearing one student clearly explain a famous theory to another, has been immensely rewarding.



I think it is important for people to have a basic understanding of ecology, even if they are not going to be a professional ecologist. Every day society is making decisions and facing issues related to ecology.

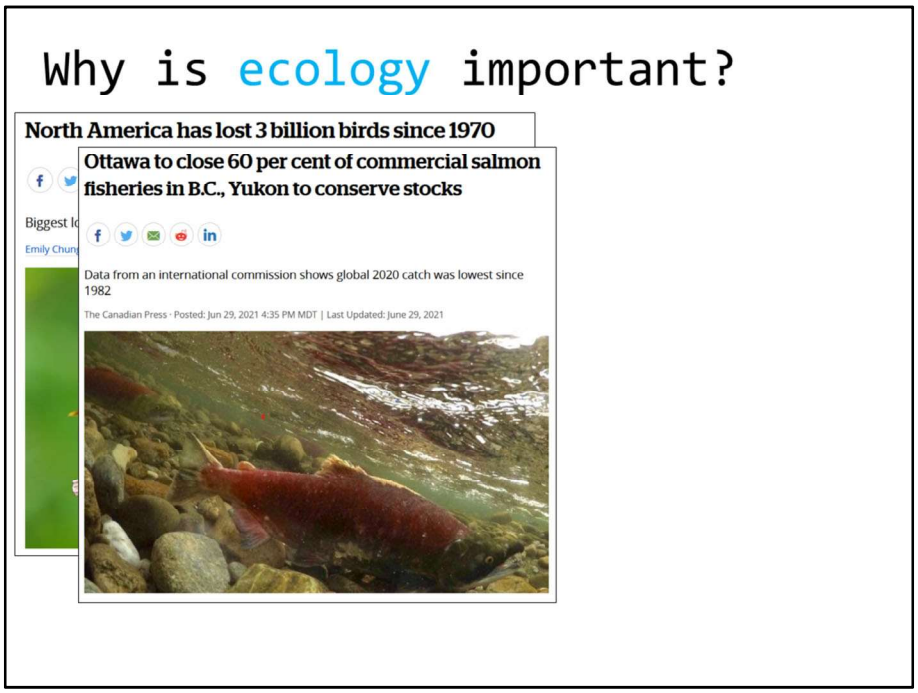
Why is ecology important?

North America has lost 3 billion birds since 1970

Biggest losses were among common species such as sparrows, warblers, starlings

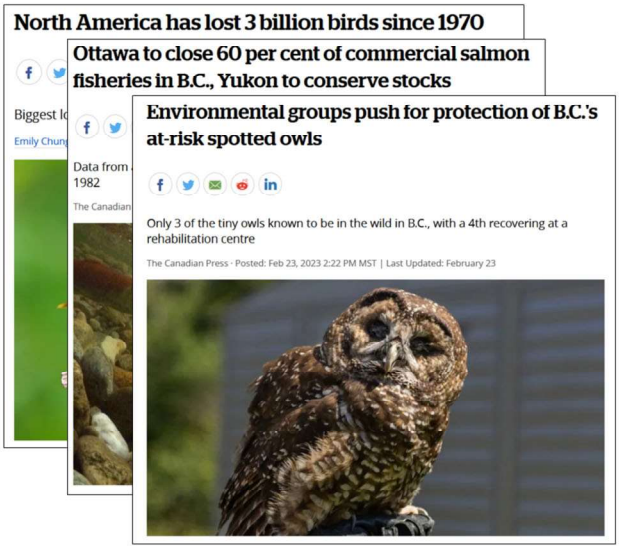
Emily Chung · CBC News · Posted: Sep 19, 2019 12:00 PM MDT | Last Updated: September 20, 2019

For example, understanding why some species are declining.

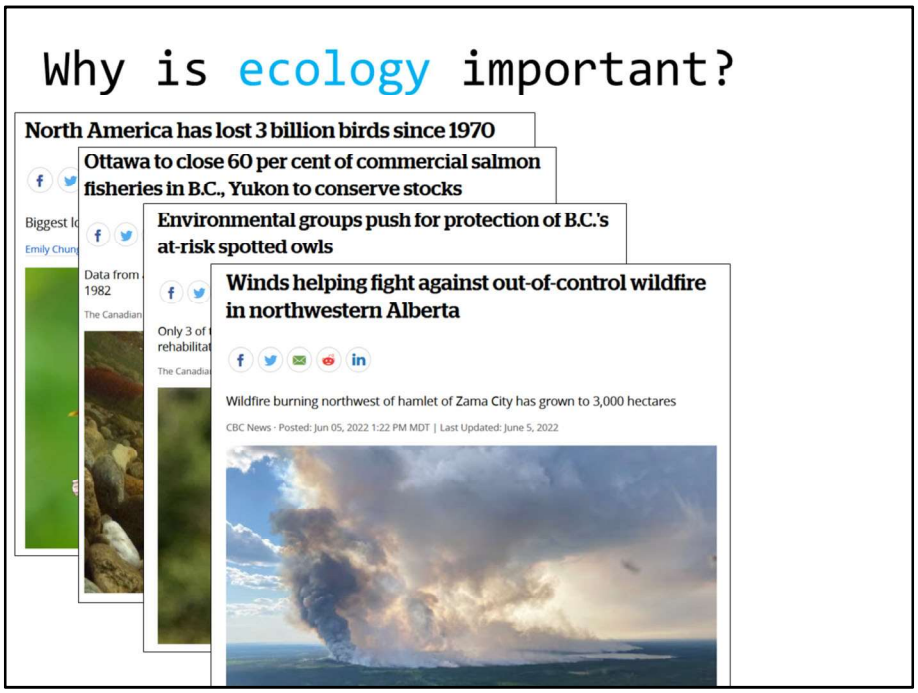


And how to prevent and reverse declines of species we care about and/or rely upon for food.

Why is ecology important?



How we can recover highly endangered species.



How climate change and human actions can affect wildfire frequency and severity.

How industrial pollution affects our air, water, and land.

Nfld. & Labrador

Does N.L. need a seal cull? It depends on which political party you ask

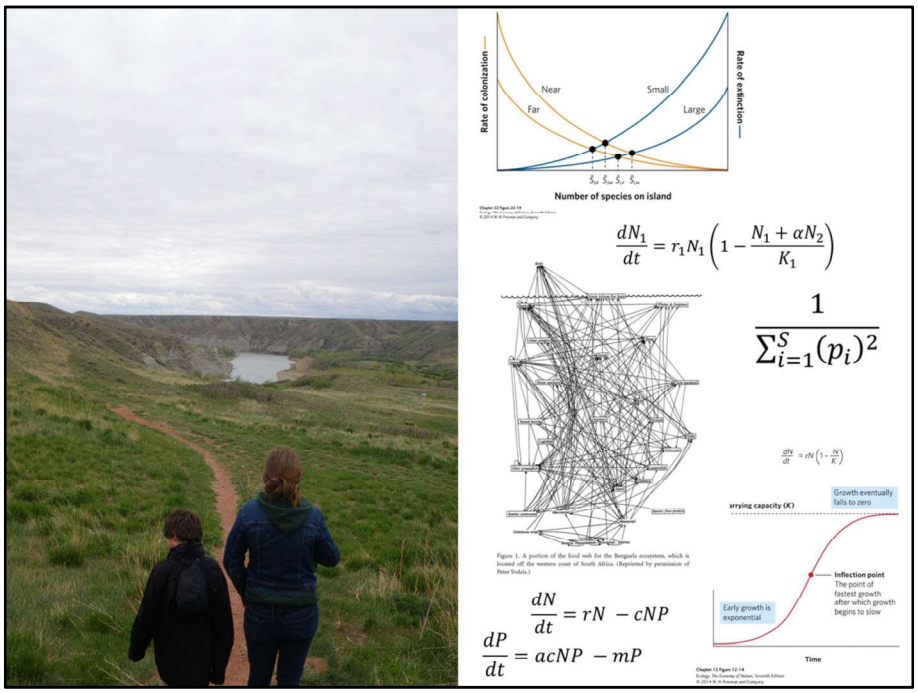
CBC News · Posted: Mar 10, 2021 10:33 AM MST | Last Updated: March 10, 2021

25 comments

The seal hunt has long been debated, perhaps not more famously than when then premier Danny Williams and Paul McCartney appeared on Larry King Live in 2006. (NOAA Fisheries)

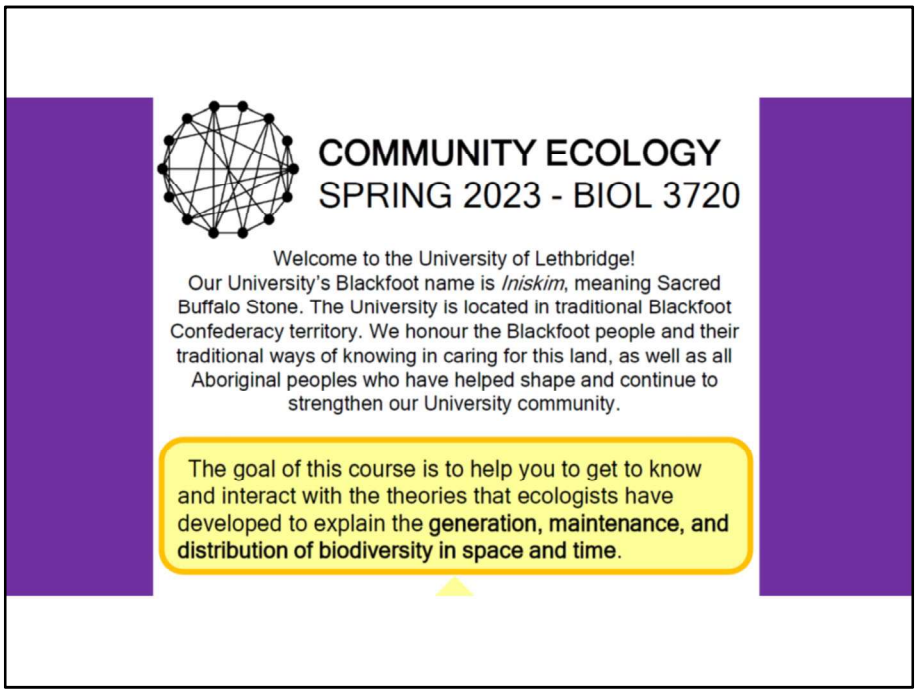
And decisions related to ecology can get political – another reason why it is important to have voters with some understanding of ecological systems and how they work.

Now… a person might think that ecology has an advantage over other subjects in biology: it deals with systems we can SEE and even HOLD in our hands. Here in Lethbridge nature is all around – we can witness a hawk preying on a ground squirrel in our everyday lives, in a way that we cannot witness cells dividing or proteins being synthesized inside of cells.

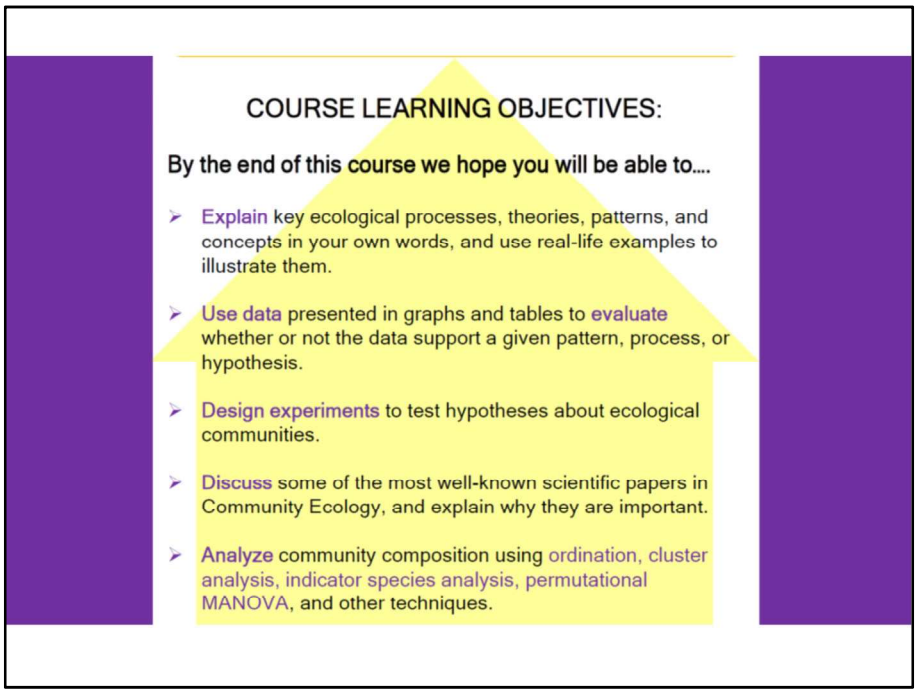


On the other hand – ecosystems are complex, and the tools that ecologists use to understand how they work involves a lot of mathematics and complex concepts and models. So some students might come in expecting ecology to be the ‘easy’ biology course.

When I was a graduate student, I took a workshop on teaching. The facilitator asked us to draw our ‘ideal classroom’. Here is what I sketched: me in a forest with a circle of happy students learning about ecology. This situation does exist, but… in real life often we are inside, with many more students.



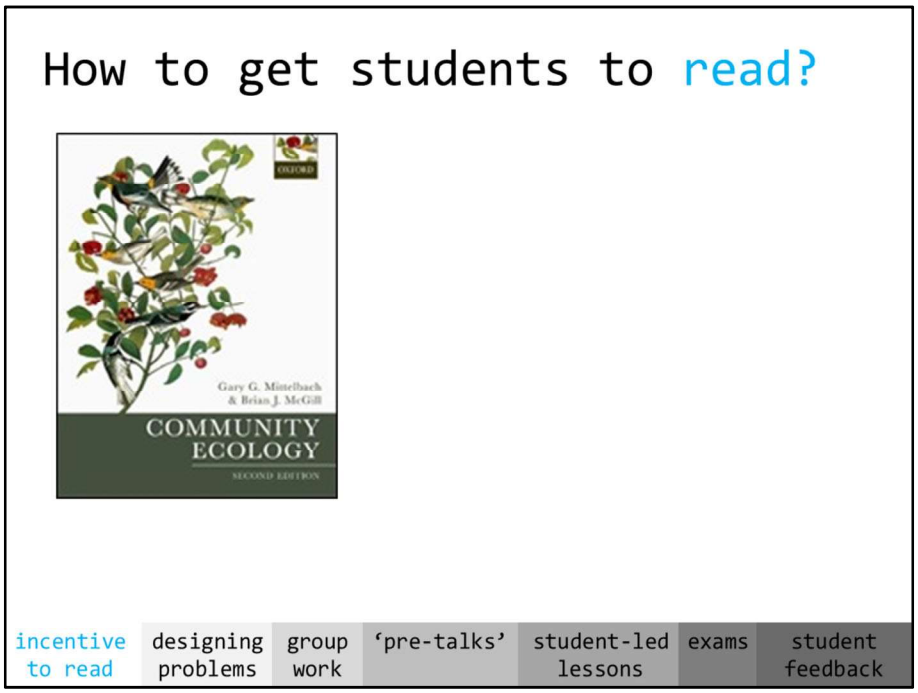
In 2020 I developed a course in Community Ecology – for the 3rd year level. The goal of the course is to help students INTERACT WITH theories that ecologists have developed (not just MEMORIZE them – but USE them and EVALUATE them).



My course learning objectives were designed to emphasize higher-level learning skills, like evaluating data, and designing experiments. The last learning objective is taken on by the lab portion of the course (now taught by Dr. Tegan Barry).

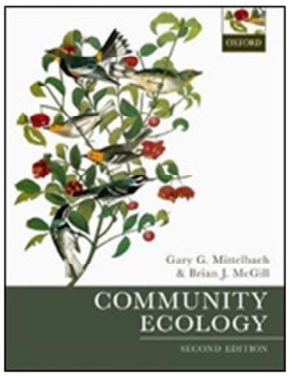
I decided I didn't want to stand up and lecture every class, so I tried a 'flipped classroom' approach, where I did not lecture at all, but students worked in groups of 3 to solve problem sets, and I rotate around helping them.

An outline of the rest of the talk….



First challenge: how to get students to READ? I find myself saying slightly ridiculous things to try to get students to appreciate the value of reading, like: "Guys! Reading is like MAGIC! If I were to stand up here and TELL you everything in Chapter 2, that would be a 7 hour lecture! But you can read it in 1-2 hours!"

How to get students to read?

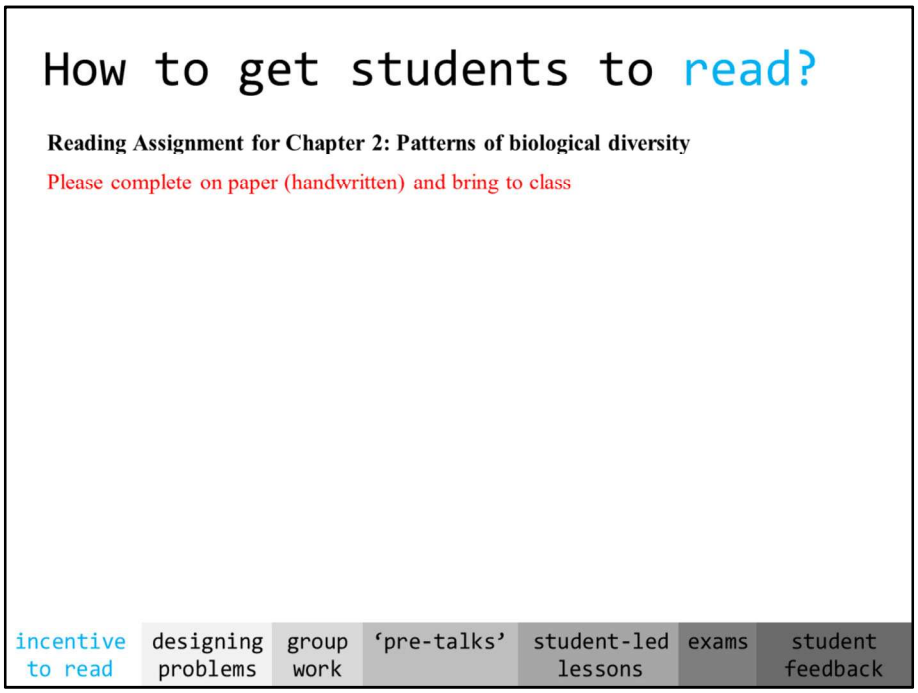


Pre-reading Assignments

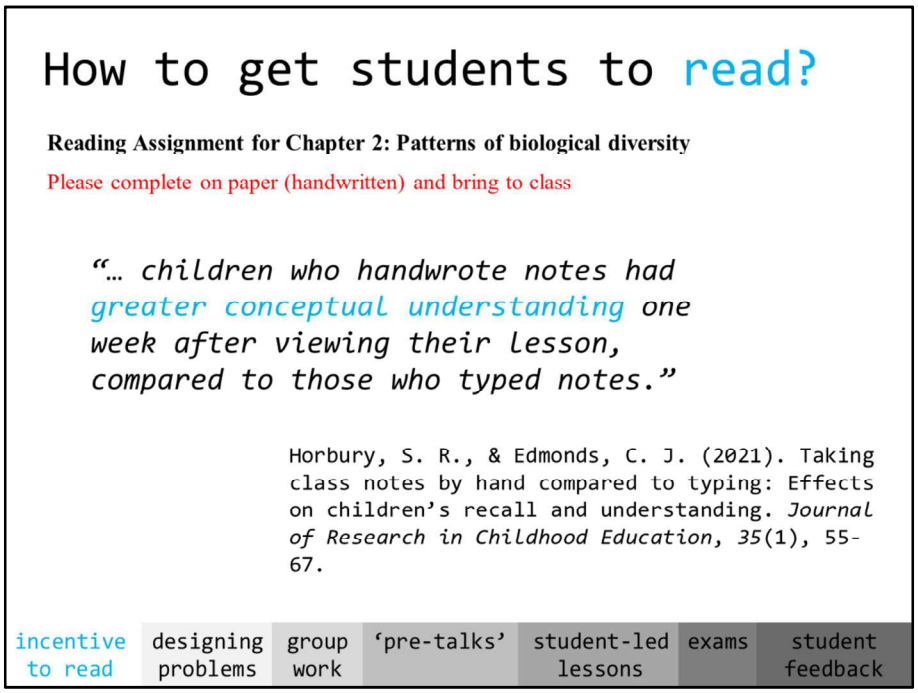
Etkina, E., & Ehrenfeld, D. 2000. Helping ecology students to read: the use of reading reports. *BioScience*, *50*(7), 602-608.

incentive to read	designing problems	group work	'pre-talks'	student-led lessons	exams	student feedback

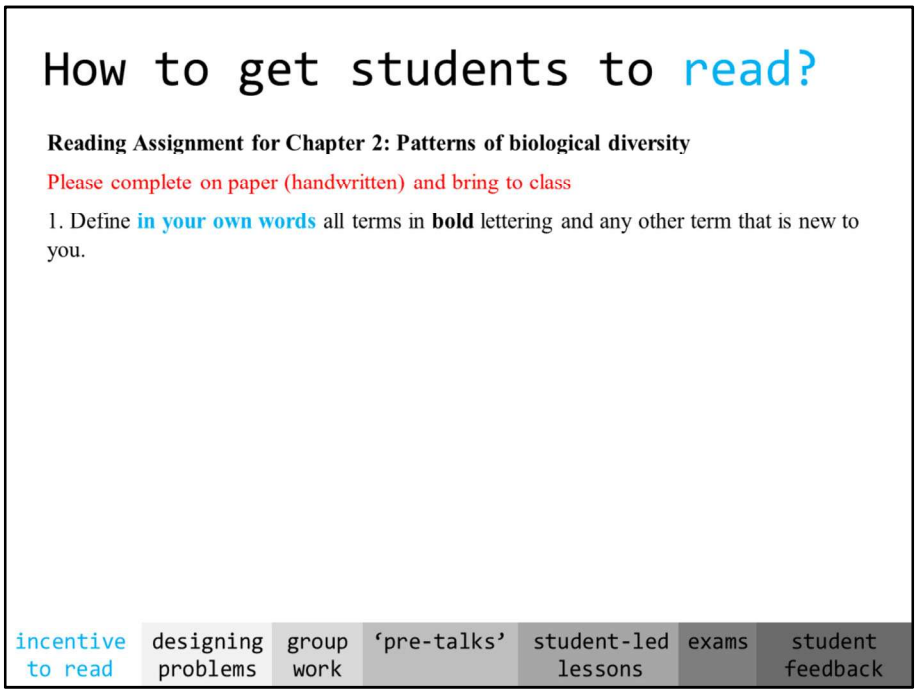
Based on this article – I used something called 'pre-reading assignments' to incentivize reading before coming to class. If students have NOT done the reading, the 'flipped classroom' idea doesn't work as well, because they have no basis upon which to try the problems.



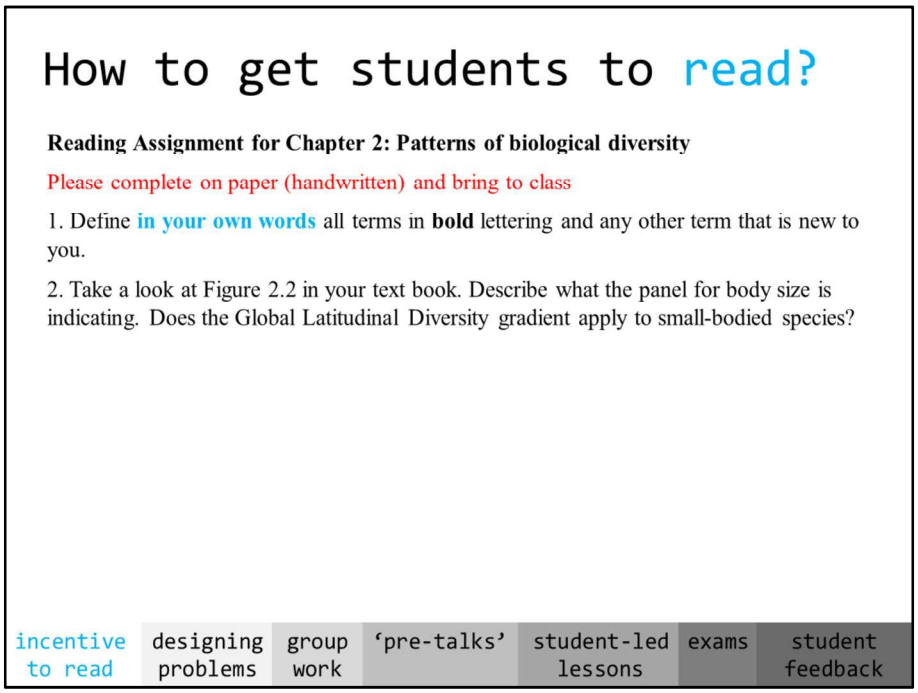
In the first few years (COVID) students typed these and handed in via email, and then Crowdmark. But this hear I insisted that they handwrite them. I have a theory that when you write something down by hand it sticks in your brain better.



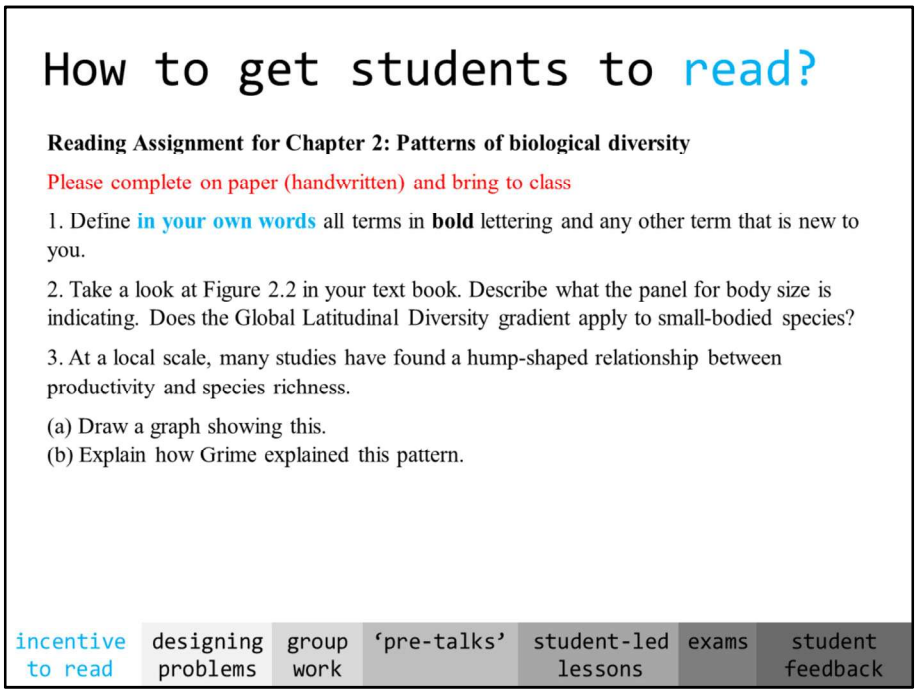
And I discovered there is actually some evidence that backs this!



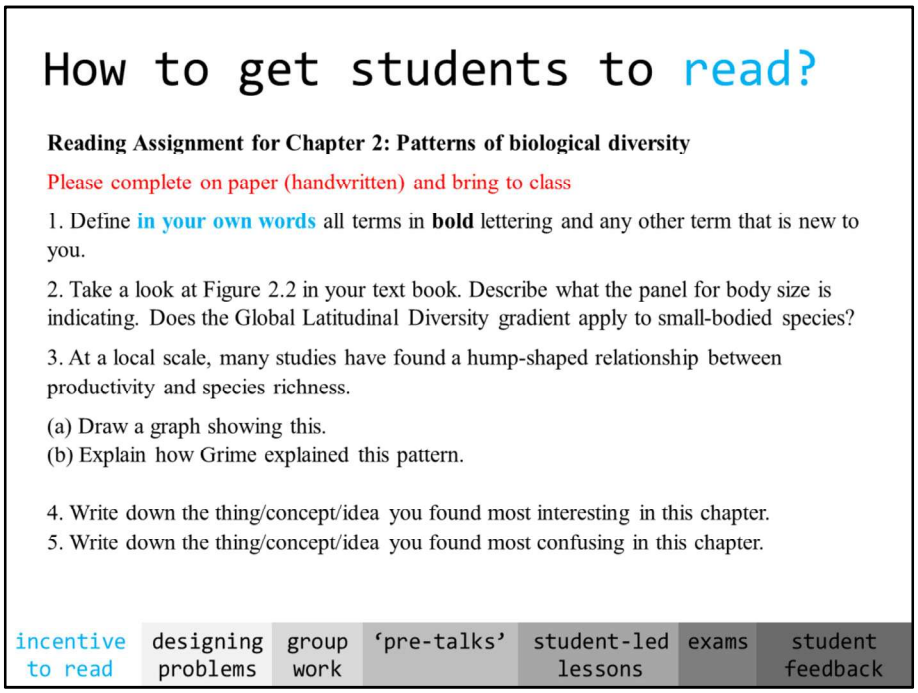
The first task is always to define terms IN THEIR OWN WORDS.



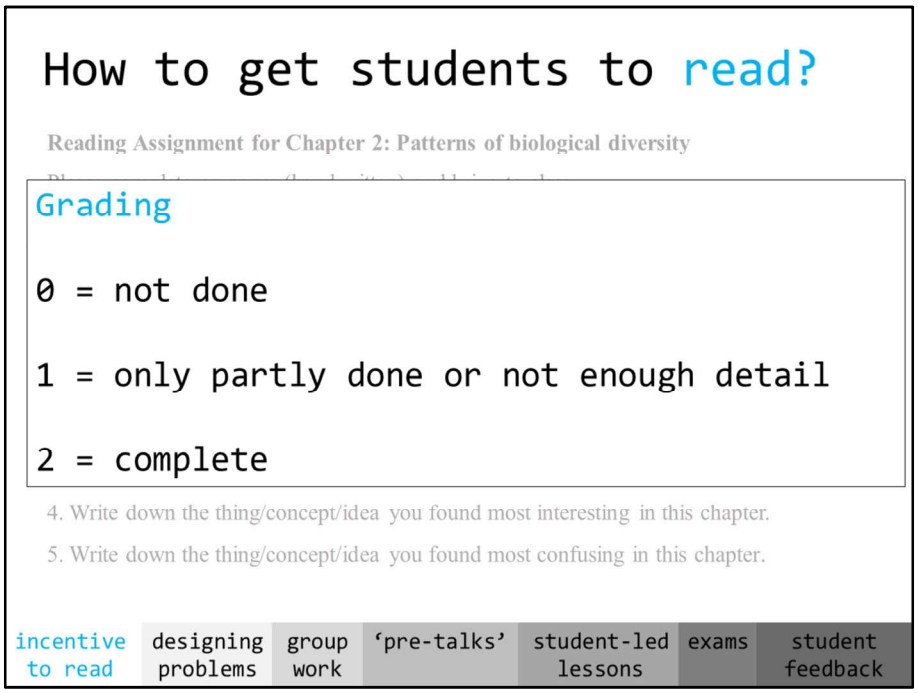
Then I usually have a question or two that encourages them to look carefully at figures or tables in the textbook, to really try to grasp what they mean.



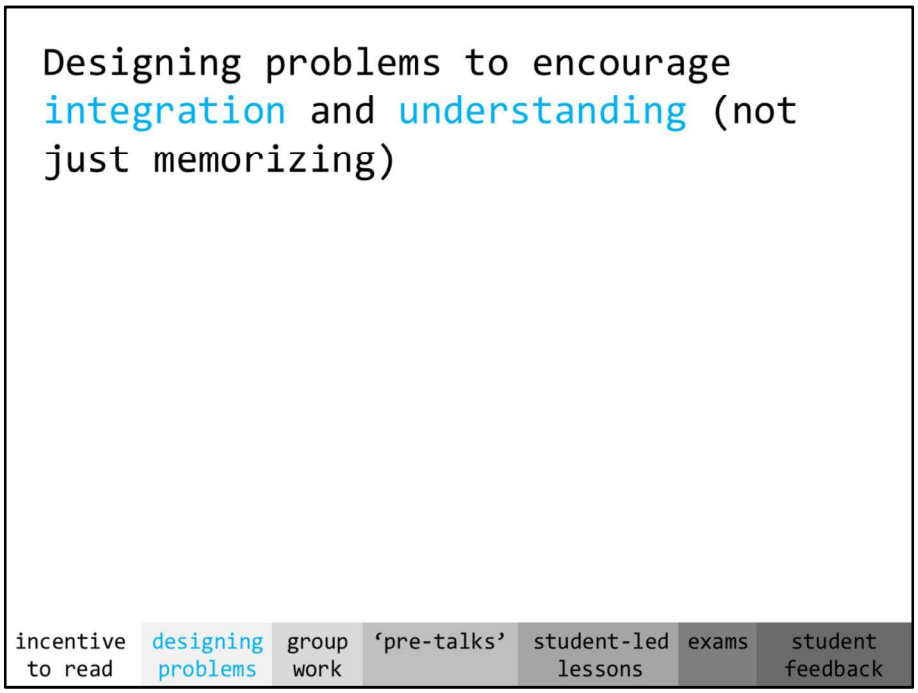
I also have learned that putting a few of the SAME questions that will be on the problem set is a good idea – and students appreciate having had the change before class to think about some of them.



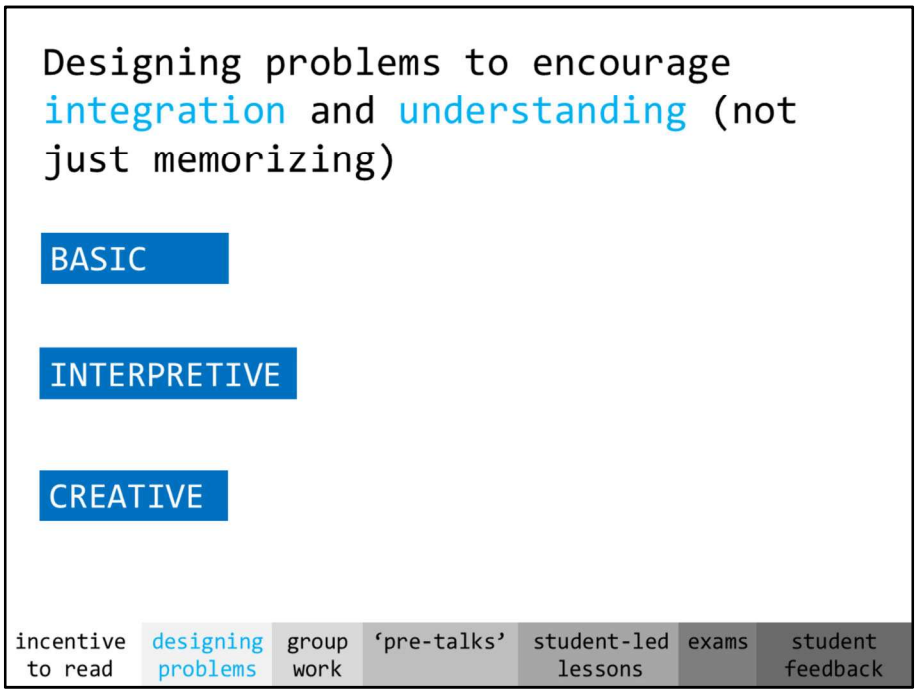
The last two questions are to encourage students to think about what things they found interesting, and what things most challenging. In the first few years I would always pay most attention to these – and I read/skimmed everybody's pre-reading assignments, so I got a good idea of what students found confusing. This year, I had 40 students and a Teaching Assistant checked these assignments, so I didn't get as much of a feel from this.



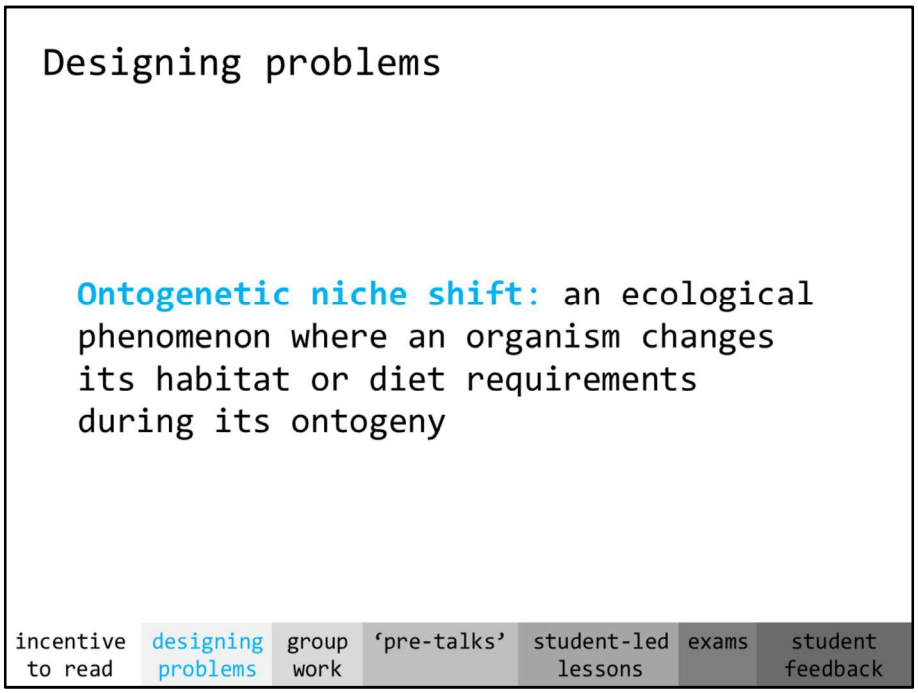
The grading of these assignments is for COMPLETION and THOROUGHNESS – NOT for correct answers. So when I check them, if I notice and answer is way off base, I might say to a student (or leave a note) saying 'check this'. But it doesn't affect the grade. The grade is for completion. Altogether these pre-reading assignments are only worth 5% of the final grade – I was aiming for enough to provide an incentive, but not so much that students would be afraid to miss one or two.



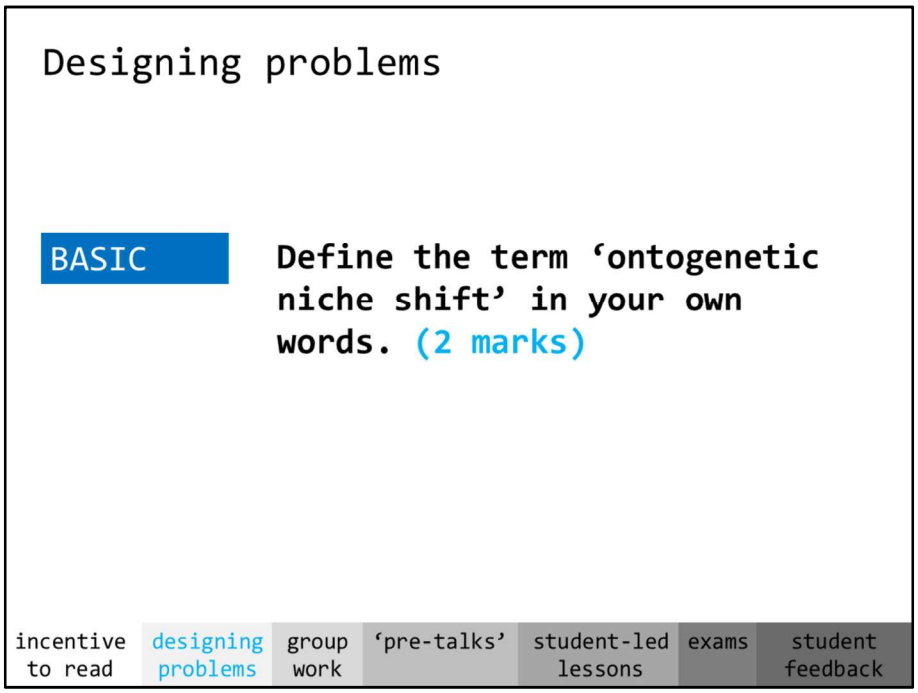
The second challenge (and major time commitment – especially at the stage of designing a 'flipped classroom' course) is designing effective problems for students to work on.



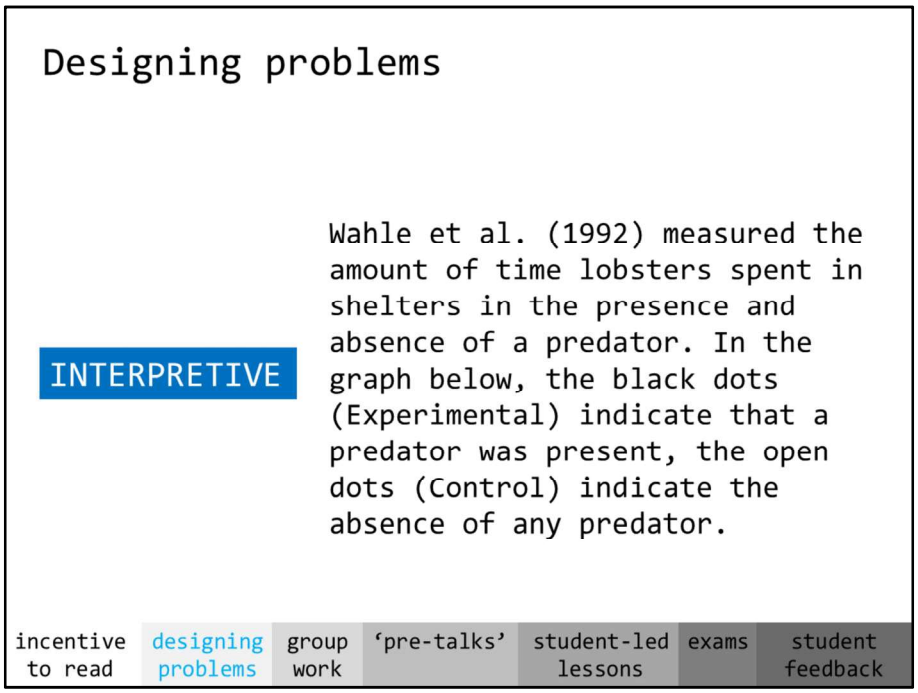
I designed all the problems I use, and I've realized they fall into 3 main categories… I'll use an example to illustrate these.



Here is a concept we discuss in class – and the 'textbook definition'.



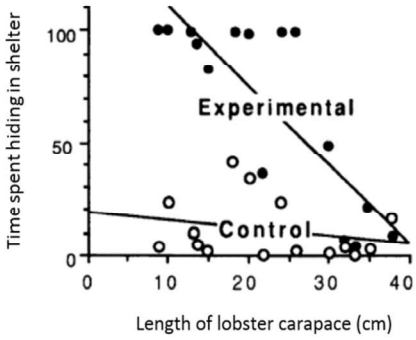
A 'basic' question might ask the students to define the term in their own words. I always caution them that if they quote verbatim from the textbook, they won't get full marks. Another way I ask these types of questions might be: "explain the concept of an ontogenetic niche shift to your friend who is an art major", or "explain the concept of an ontogenetic niche shift as you would explain it to your 9 year old cousin".



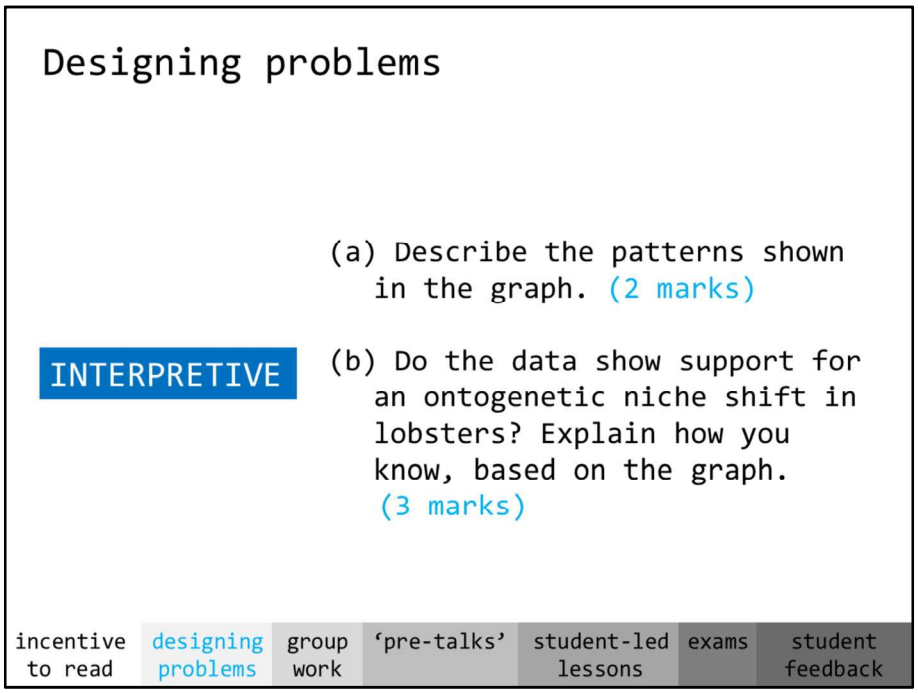
With interpretive questions, I like to show the students REAL DATA (from real studies) and ask them to determine whether or not the data support the concept or theory.

Designing problems

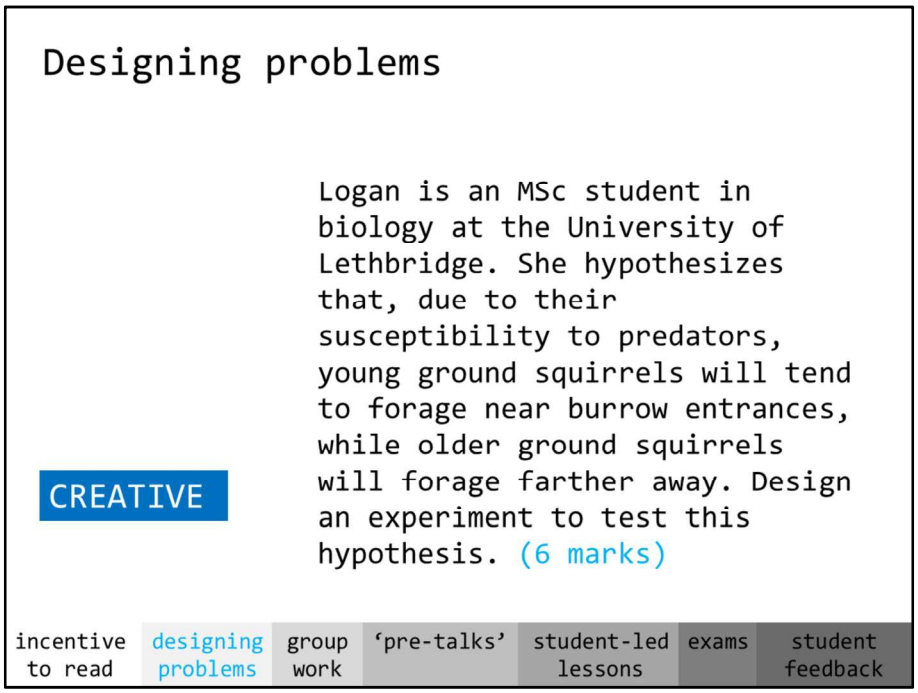
INTERPRETIVE



incentive to read | designing problems | group work | 'pre-talks' | student-led lessons | exams | student feedback



I learned that I had to ask them to 'describe the pattern shown in the graph', not 'describe what the graph shows', because with the latter, many students will write "the graph shows the relationship between y and x", but not what the SHAPE or PATTERN of the relationship is!



In a 'creative' level problem, I might ask students to design their own experiment to test the concept or theory.

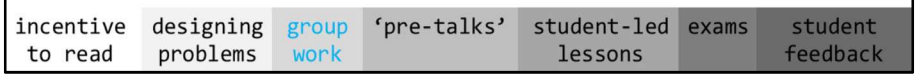
As you can imagine, designing problems takes a VERY long time – especially delving into the ecology literature to find good datasets that aren't TOO hard for students to evaluate.

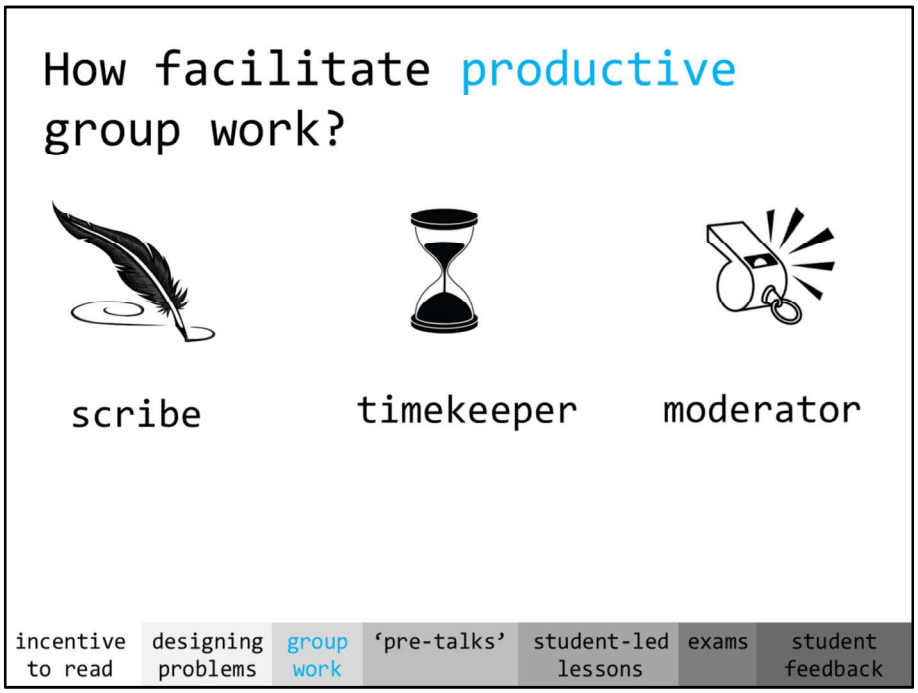
But… many students don't appreciate how much time that takes:

Designing problems

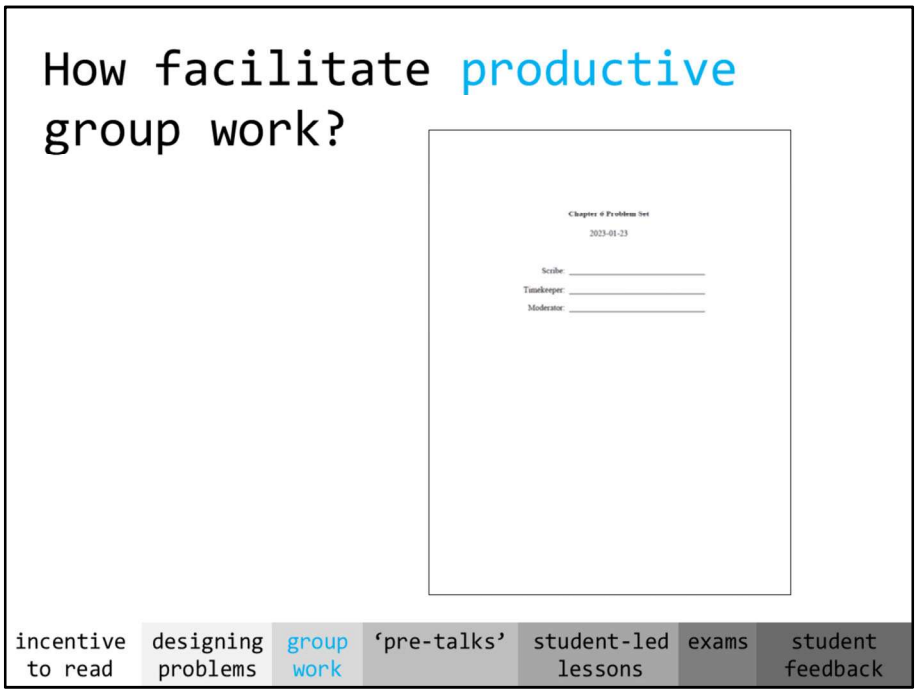
Jenny is the worst instructor I've had in my entire academic career. […] She amassed maybe an hour of lecture in three months and she completely relies on students to teach themselves, without outlining any important concepts. […] The textbook was the instructor, she did less work than a T.A

How facilitate productive group work?

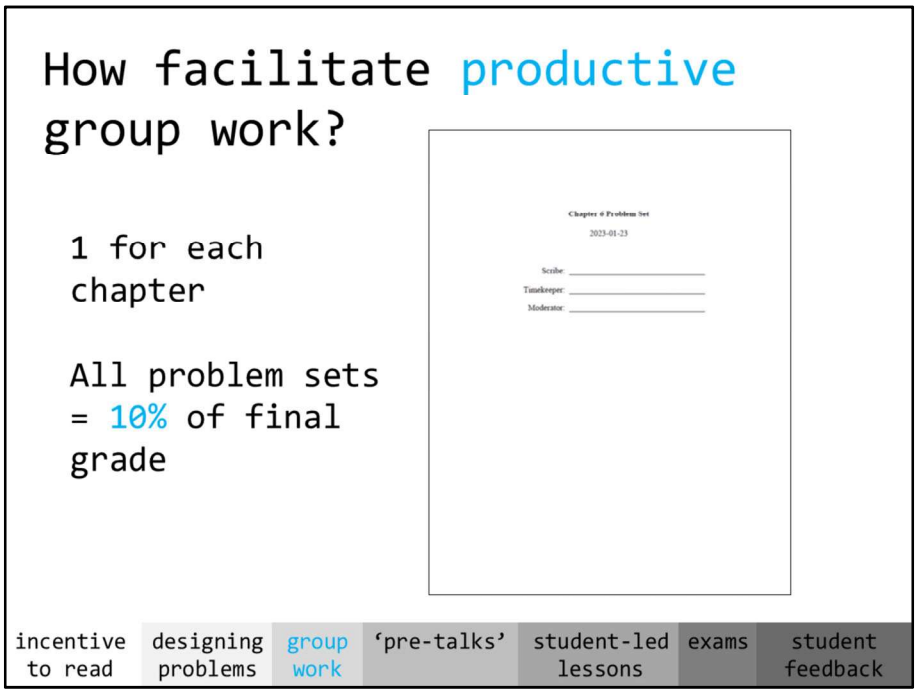




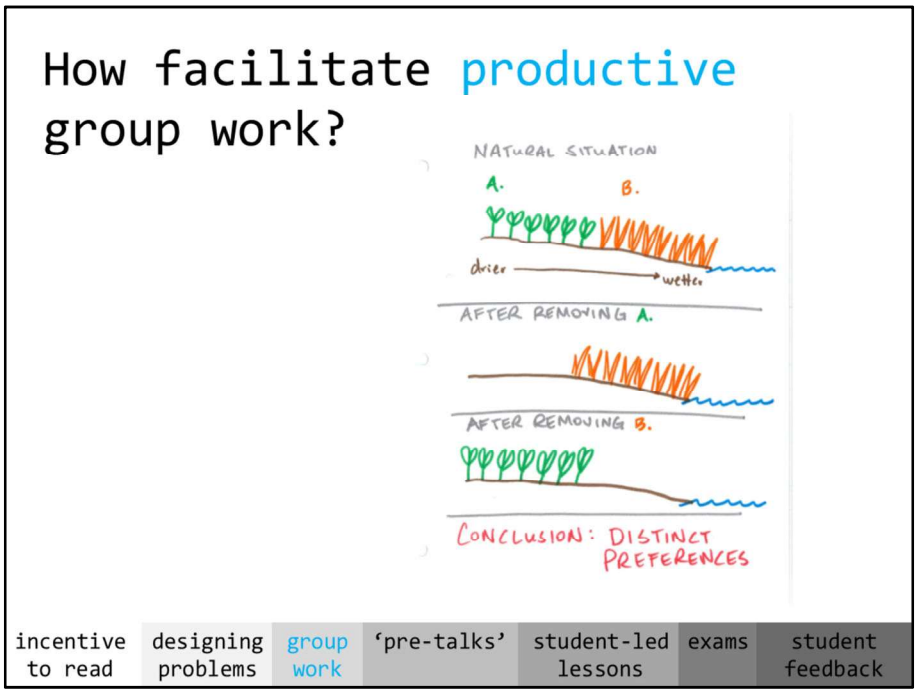
One thing I do to try and help facilitate productive group work is to model – on the first day, and every session – how each student has a role to play.



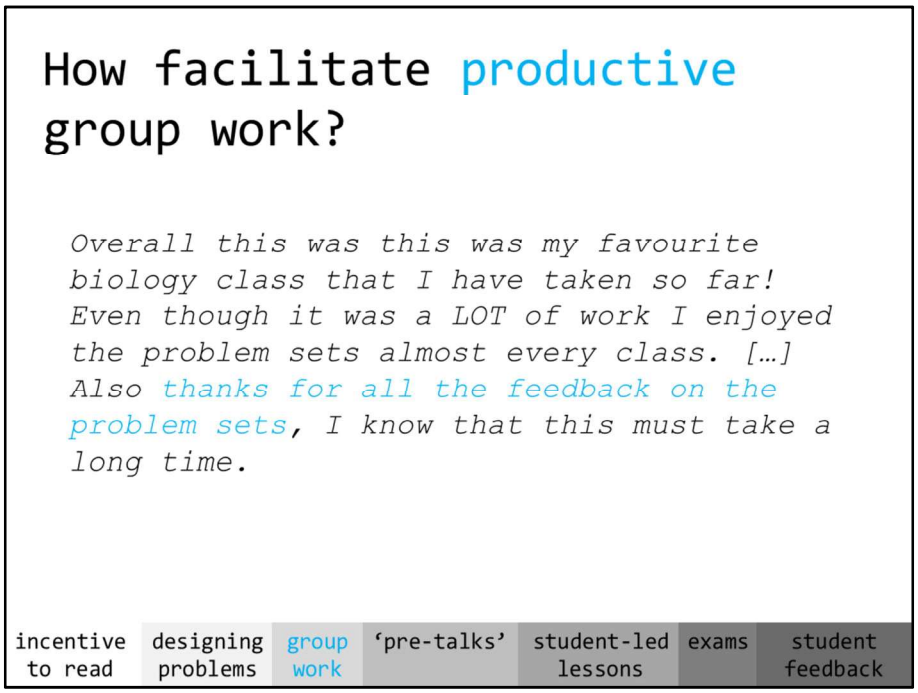
So… in each session, I distribute a problem set to groups of 3 students.



There is one problem set for each chapter, we do them for 15 chapters, and all the problem sets together are worth 10% of the final grade. I try to impress upon students who are worried about getting lower grades than they might like on the problem sets – that these are PRACTICE – and that each one is worth less than 1% of their total grade, so if they have to miss class, or if they have a poor one –it is not the end of the world.



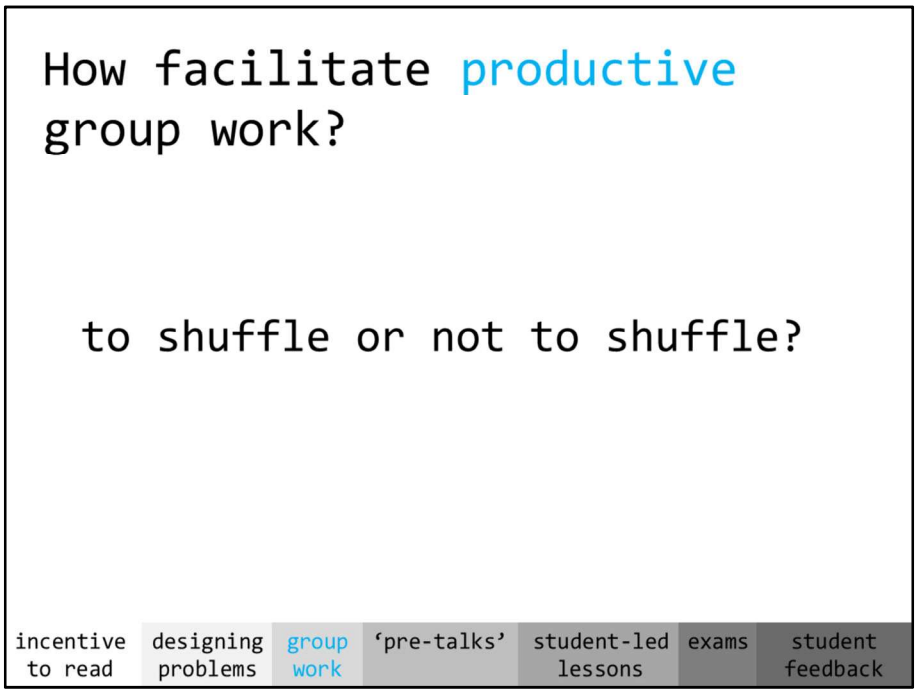
In the first year, I did not do a formal lecture at all. I circulate around to all the groups (or among breakout rooms in Zoom – which isn't as nice). And sometimes I draw things on the board like this – to try and help them grasp concepts.



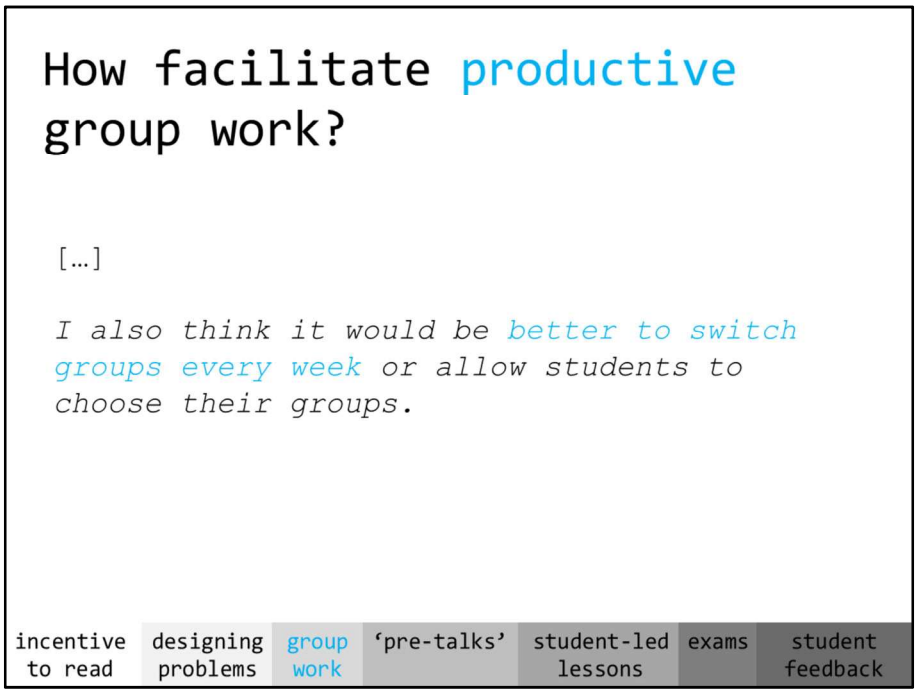
I give extensive feedback on the problem sets. This became easier when I learned how to use Crowdmark and could just drag and drop previous comments on to the assessment. Crowdmark is also great because every student can download a copy of the problem set – rather than handing back a paper copy that the 3 students in the group then have to try and share somehow.

Some students really liked this problem-based set up – and even appreciated the time I took to give such detailed feedback.

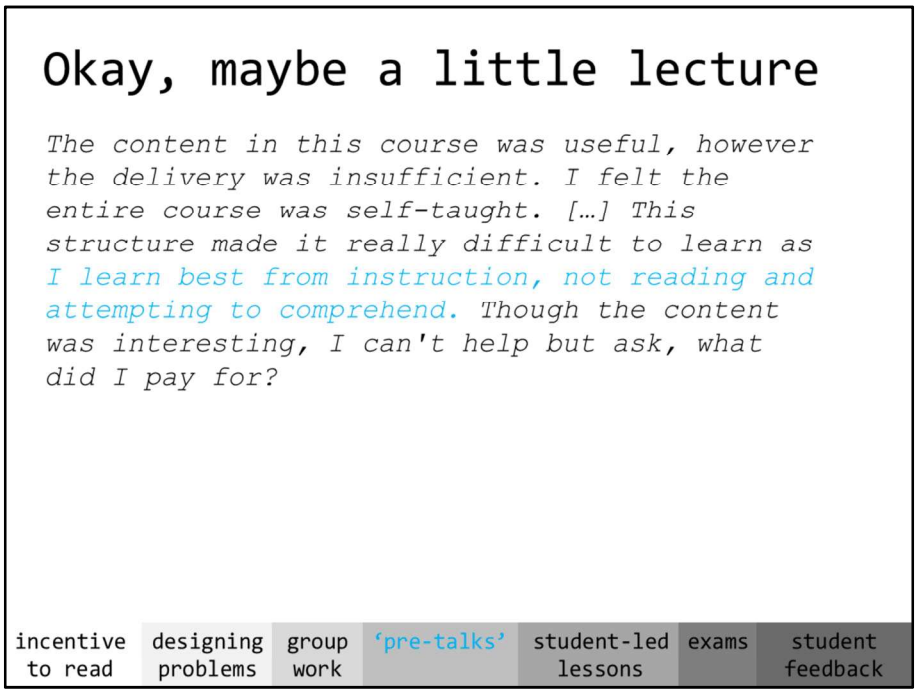
Yes, it DOES take a long time. Usually 3-4 hours of grading per week.



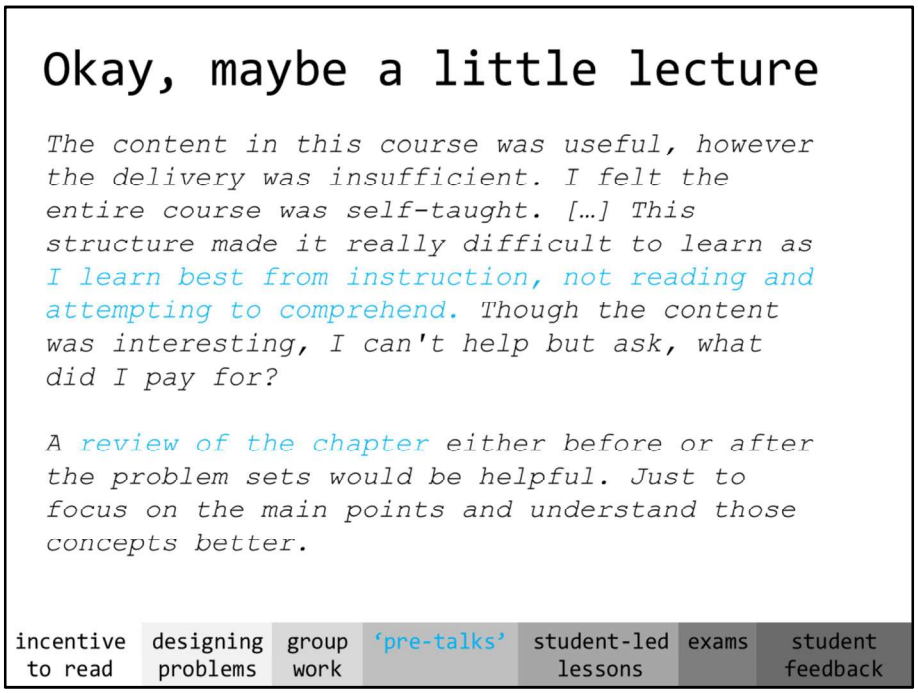
In the first year: I randomly sorted students into groups on the first day, and they stayed in the same group all semester. Most groups were productive. Some were extremely productive. Only one (out of 9) was pretty dysfunctional.



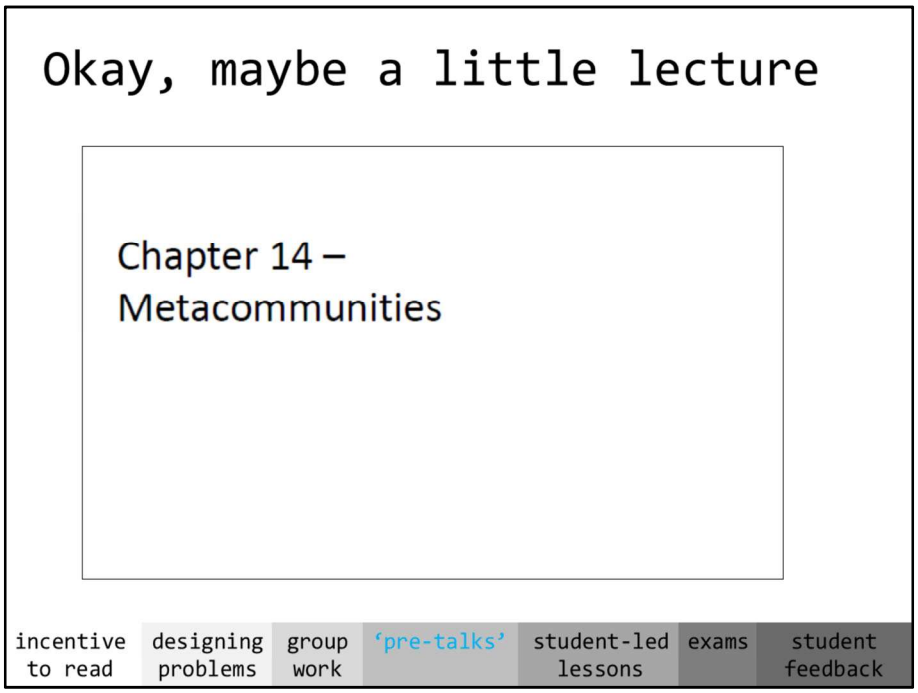
But… the second year had more than one very dysfunctional group, and I got a lot of comments suggesting shuffling groups, or allowing students to choose.



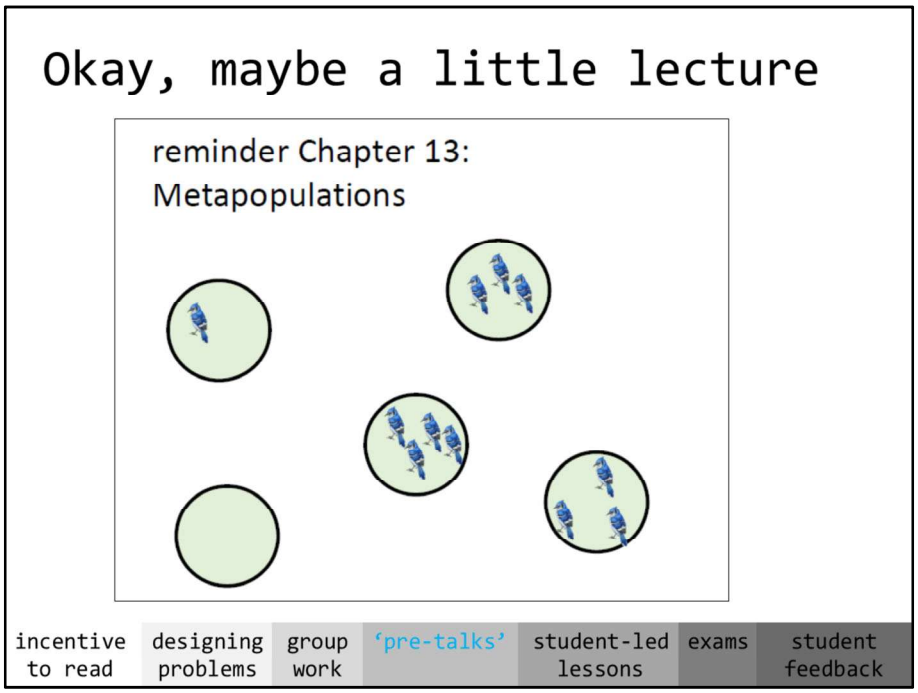
Some were VERY disgruntled.



Others were more constructive, and I thought: okay, I could give little 'mini lectures', just on the things that most students tend to find confusing.

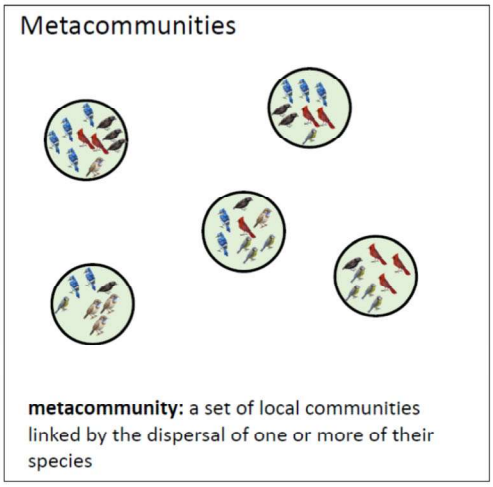


So, starting in the second year I taught the course, I would give a little 'pre-talk' at the beginning of each session. Each was only 7-15 minutes or so.



On Zoom, I would give them using a tablet, so I could share the screen, and scribbling diagrams on top of the slides. Back in person, I use a printed page and a document camera to demonstrate things as a talk.

Okay, maybe a little lecture



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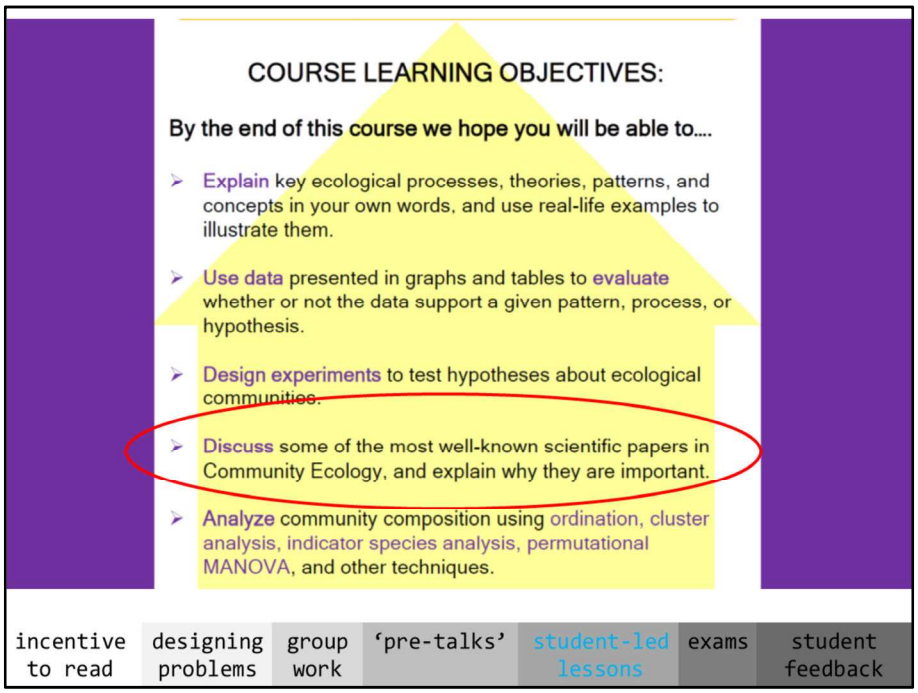
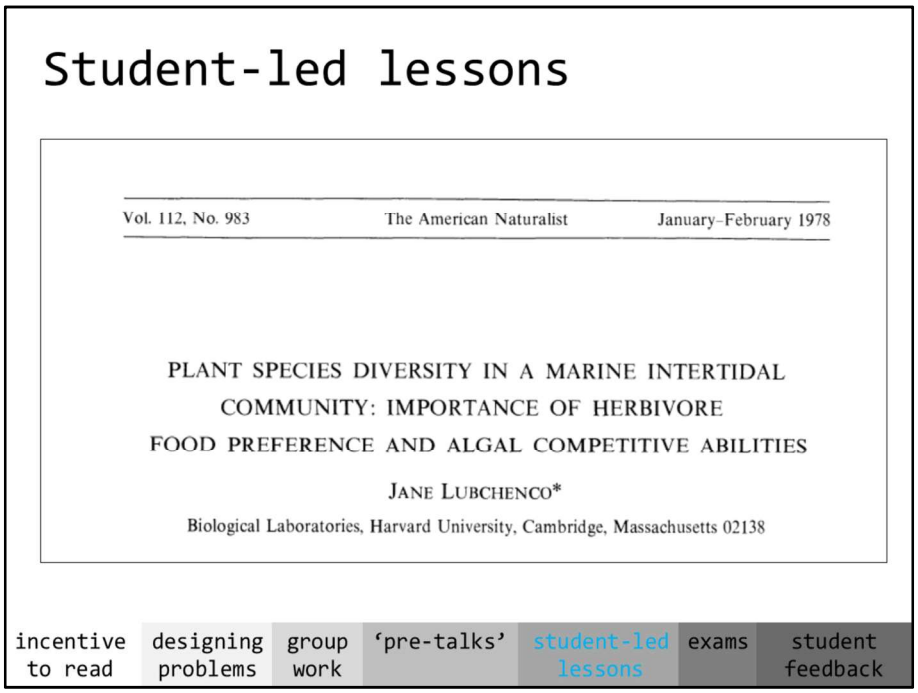
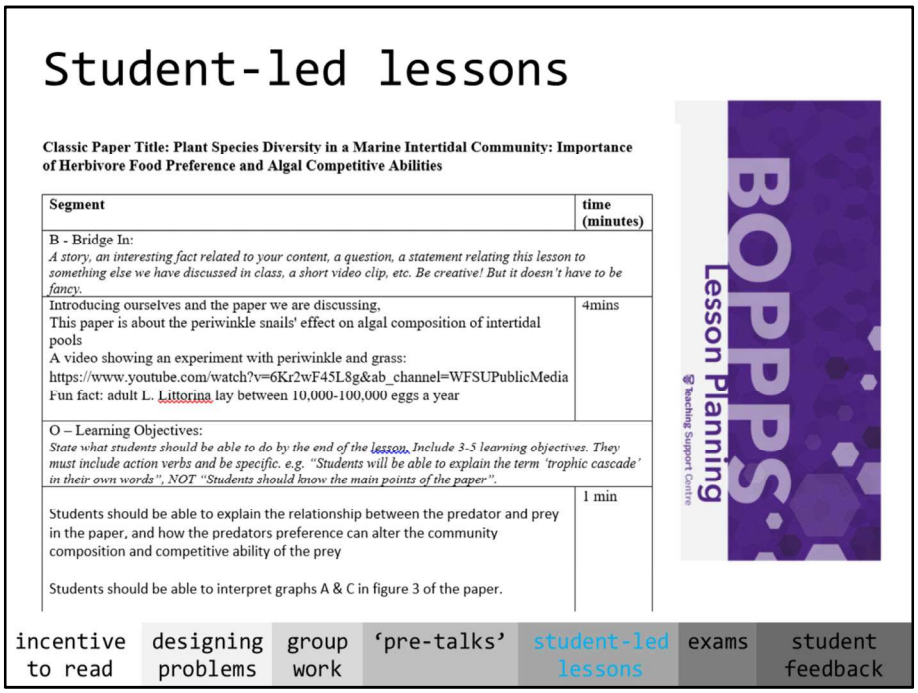


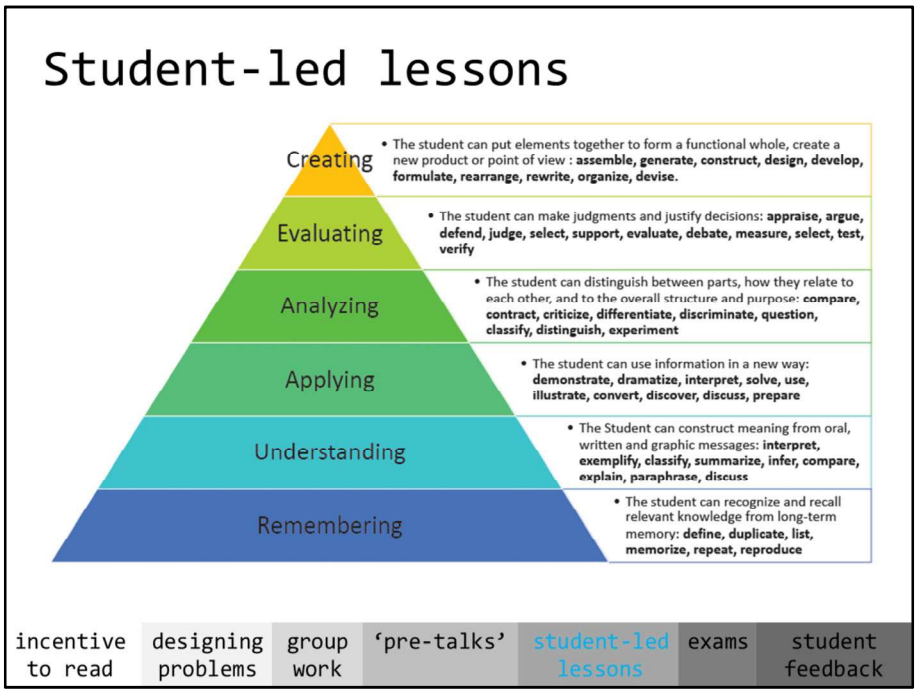
I haven't yet talked about how I tried to accomplish this learning objective…



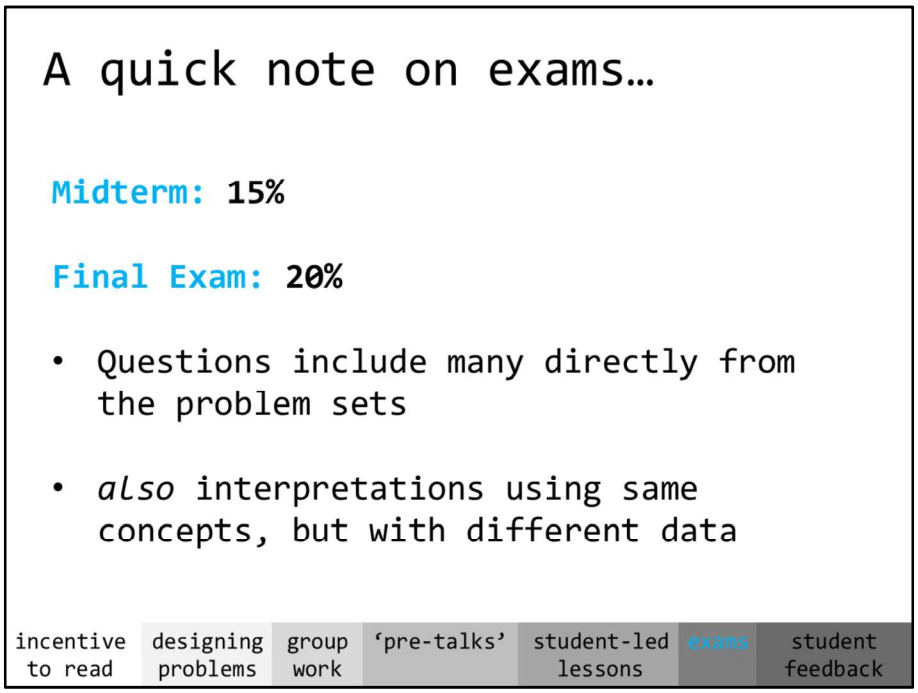
To expose students to the primary literature, I selected 9-13 'classic papers' in ecology. Students choose their own group of 3 students, and each groups presents a 'student-led lesson' on one of these papers. The idea is not for them to do a 'presentation' on the paper, but to design a lesson using the BOPPPS lesson plan format, with active learning, to engage their peers.



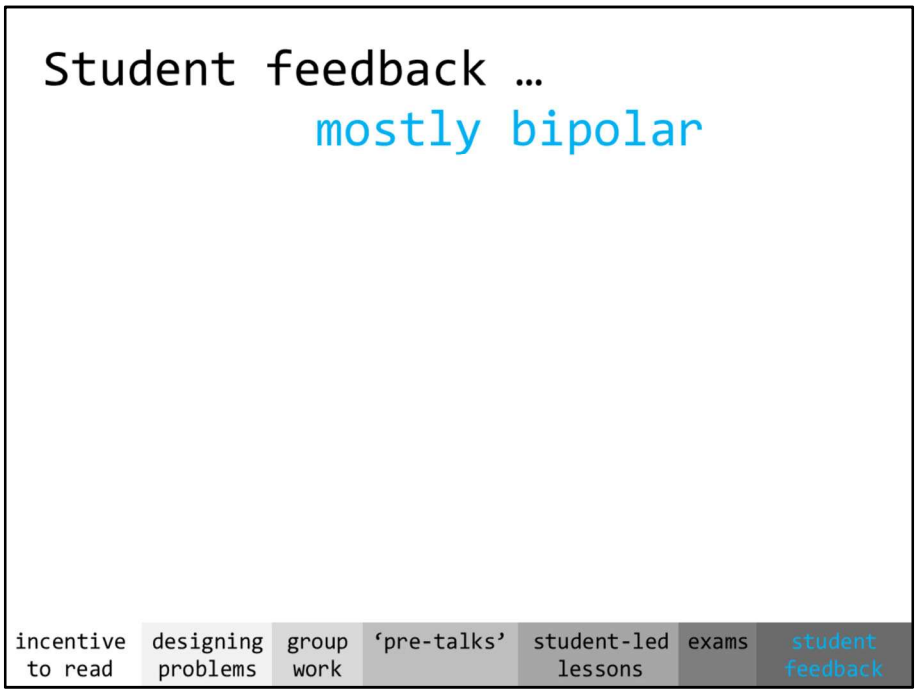
As part of the assignment, they have to hand in their lesson plan – I give them the template.



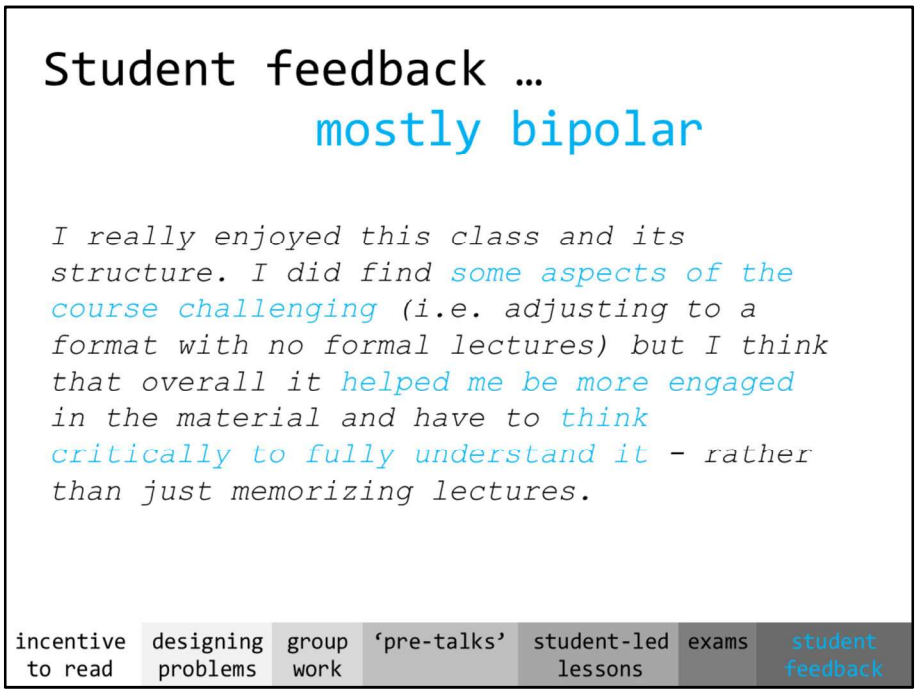
For their learning objectives, I challenge them to use higher-order learning verbs. To emphasize what students should be able to DO – not what they should know. This is a version of Bloom's taxonomy of learning objective verbs – which I provide to the students to use. Many of them come up with very creative participatory learning activities – games, participatory simulations – sometimes a bit too much 'Kahoot' quizzes.



I DO use exams – which students do individually. These are very traditional, but they include MANY Of the problems on the problem sets – so students are rewarded for checking my comments on their problem sets. I also like to ask interpretive questions – but with a different data set than the one I used on the problem set.



Often I get VERY diverging evaluations – the students who do the evaluations seem to be those that either LOVED the course (and me), or HATED THE COURSE VEHEMENTLY (and also me).



The ones I appreciate most are the constructive 'middle ground' ones – that show that the course was challenging, but that the student realized what I was trying to do.

Student feedback …
mostly bipolar

I really enjoyed this class and its structure. I did find some aspects of the course challenging (i.e. adjusting to a format with no formal lectures) but I think that overall it helped me be more engaged in the material and have to think critically to fully understand it - rather than just memorizing lectures.

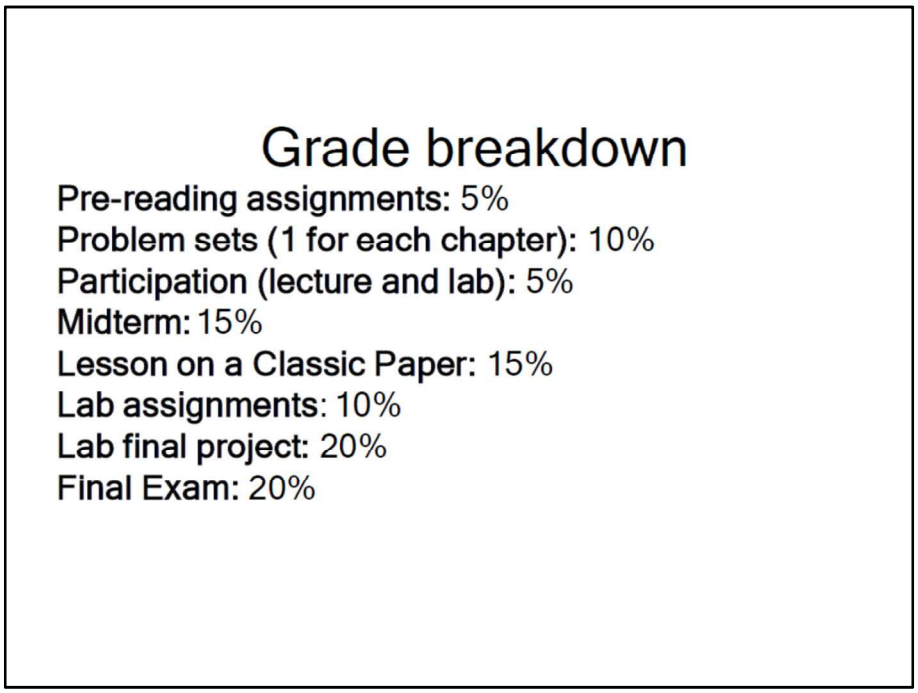
incentive to read | designing problems | group work | 'pre-talks' | student-led lessons | exams | student feedback

These types of reviews are very rewarding.

The End

I really enjoyed this class and its structure. I did find some aspects of the course challenging (i.e. adjusting to a format with no formal lectures) but I think that overall it helped me be more engaged in the material and have to think critically to fully understand it - rather than just memorizing lectures.

Questions and Feedback Welcome



In case people wondered: the grade breakdown.