Hello, and welcome to Linear and Abstract Algebra for Educators.

I am Laurel Langford. I have been teaching at UWRF for about 20 years, and I have taught a lot of courses that are abstract math courses, and a lot of courses that are math education courses.

I am currently wrapping up my yearly trek to Utah to see my extended family. I have three children, the older two of which should have moved on to their own lives and families, but whom I am delighted are still hanging out with me for a little longer. I love talking to students of all ages about Math--I enjoyed years of volunteering at the Montessori Elementary here in River Falls (where my younger two children went to elementary school). I am happy to live in River Falls, where I have the shortest commute I have ever had (5 minutes!)

As regards math education: I regularly teach the Math for Elementary Education classes, which include some middle school math teaching and learning content. Once upon a time I taught the teaching math with technology class as part of the secondary education math program—sadly that was quite a while ago, and so I'm pretty rusty on that content.

I have been teaching the Abstract Algebra class for the undergraduates for the past 2-3 years, and I've figured out some things about teaching Abstract Algebra that I'm excited to use in the context of this graduate level class. I haven't taught Linear Algebra (that's the matrices and vector spaces) for a long time, but as I think about that content, I keep thinking of more cool things I'd love to share (more than we will have time for I expect).

I have taught this class 3 times before, and loved it every time I have taught it—I really appreciate what you (as thoughtful teachers) bring to the class, and I love sharing interesting mathematics with people like you. I haven't taught it recently (the last two times it was taught by other people), but I'm looking forward to it.

About the class

Two of our math faculty collaborated on the official course description (which is in the syllabus). One of them wrote the course objectives and the structure of the course, and the other wrote the list of topics. Sadly, I am neither of those people, and so while I will do things that address both the official objectives and content, the flavor of the course will be a little different from what you might expect by reading the official document. I think of this class as having 3 pieces: abstract algebra, linear algebra, and algebraic pedagogy.

Linear Algebra

Wow, I have so many favorite things to do in linear algebra—I really love to share the aha that Gaussian Elimination is way more efficient than you'd think when you're first learning it. I remember when I first learned Cramer's Rule for solving linear systems (using determinants), I thought that it was so much better than Gaussian Elimination, and then I was surprised when I

later realized that for a lot of cases Gaussian Elimination is faster and easier. This is such a fun, accessible investigation that in the past it's been part of what I do with this class.

I'm slowly convincing myself that the most important linear algebra thing we could do is to investigate the geometric interpretations of what you do when you are solving a system of equations by Gaussian Elimination. I can sense a really cool pattern lurking in the geometry of this technique if we just keep track of everything—I hope you'll help me solve it, and we'll all get to bask in our awesomeness in discovering some cool mathematical connections.

Linear transformations (linear functions on vectors) turn out to be really cool, and vector spaces are going to be important when we get to Abstract Algebra too, so we will spend some time thinking about $\mathbb{R}^2$ (2-dimensional vectors) to prepare for the big ideas of vector spaces.

Abstract Algebra

I think that hardly anyone really appreciates Abstract Algebra after their first experience with it as an undergraduate. You learn a lot of definitions, and some examples and theorems, but since you don't use again right away, you promptly forget it all. In this class, almost all of the abstract algebra we will do will be focused towards solving a single, famous problem: that an angle cannot be trisected by a straight edge and compass. To solve this problem, you'll need to know some geometry (for the construction part), some trigonometry (for analyzing what a trisection is), and some abstract algebra (fields, groups and vector fields mostly) to create the mathematical machine that shows that the trisection can never be accomplished. It turns out that proving that something *can* be done is pretty easy (here are the steps, now do it), but proving that something *can't* be done is really hard. Abstract Algebra was invented to prove that things like this can't be done. (The prior sentence is mostly, but of course not entirely, true).

At the end, I don't expect that you will remember all of the definitions and theorems, but I hope you'll have a good example you can share of how mathematics gets created, and how lots of pieces of math from different areas come together to solve a single problem.

Pedagogy and Pre-Calculus Algebra (in which I include almost all of high school and middle school mathematics)

My best results in talking about pedagogy occur when I start with the ideas and experience you all bring to the class, so I'm going to start by asking you to share an algebra lesson or teaching strategy that you're particularly happy with, and I'm going to try and weave as many of those into our class discussions as I can. I will also set aside some time each week (and more during the last week) to explore and discuss your discoveries both mathematically and pedagogically. Some of these discussions will relate to linear or abstract algebra, and some of them won't. Some of the linear and abstract algebra will relate to pre-calculus algebra, and some of it won't.

As much as I can, we will relate the pedagogy to the abstract/linear algebra, but there will be times when we will talk about linear or abstract algebra for a long time without looking at an

application, and there will also be times when we talk about pedagogy and pre-calculus teacher knowledge, and we won't mention abstract/linear algebra. I am planning to front-load the linear/abstract algebra to a certain extent, because I want to make sure that I'm not giving a test on something we only just got to at the end of the day before, but I will do my best to pay attention to the pedagogy too.

I hope my approach to this class is one that you can enjoy (if you're worried, email me to set up a time and I'll be happy to talk to you about it).