Growing up, school was always something which had come easily to me. One middle school teacher quoted a classmate of mine to my parents, "If you don't know the answer to a question, just wait; Anna will answer it." As my self-awareness developed with age, experience, and maturity, I learned that although such a reputation felt satisfying in the moment, it contradicted my deeply held ideals of a classroom in which all members of the community participated in the sharing of ideas and construction of knowledge. Instead of loving the praise and validation for producing a correct answer, I developed an appreciation for the sound of other voices and perspectives over my own.

Throughout my schooling, math was always a strength of mine, but not a love. With elementary school teachers who taught the subject as a series of algorithmic procedures (perhaps due to their own challenging experiences in mastering the subject), I saw math as a skill to be mastered, something I could be "good at," but no more.

> *As far as math anxiety, "many many more girls and women than men are anxious," said Jo Boaler, a professor of mathematics education at Stanford, "and we know anxiety holds people back — there are still messages out there that math is for boys and not for girls." Some of the anxiety, she said, may be transmitted by elementary school teachers, who are likely to be female, and are often themselves anxious about math. "We know that girls identify with their elementary teachers," she said, and are more likely than boys to be affected by the teacher's math anxiety, if it is present, contributing to what she called "the cycle by which this continues."*

As I progressed through school, I encountered math teachers who loved the subject and infused their teaching with this love. I learned that math was not only something to be memorized, practiced, and executed on a test, but rather a fountain of patterns to be investigated, observations to be tested, theorems to be proven, and real world problems to which all of the above can be applied. These new discoveries were accompanied by a special teacher creating the opportunity for me to student-teach a class. Until this experience, I had always been externally driven toward engineering as a career, a field where I could make an impact as a strong and successful female, yet lacking in passion for me. Suddenly, I saw a place where I could fuse my love for learning, working with others, and mathematics.

Entering my college career, I had a naive understanding of what it meant to teach and be an educator, but my education coursework began to open my eyes to both the challenges and the potential of what I could train to become. Once again, however, I had teachers who loved English, art, history… but never math. Through this time, my drive for equity and cultural awareness was ignited, however, I still had experienced primarily traditional teaching styles for mathematics. Within my internship year teaching experiences and the first courses of my Master's of Arts in Education (MAED) at Michigan State University (MSU), I was exposed to progressive and experimental mathematics teaching that enkindled a deeper desire and understanding of meaningful mathematics education.

The earliest coursework in my master's program was TE 802/804 - Reflection and Inquiry in Teaching Practice I & II, which accompanied both semesters of my student teaching internship year. This course began my journey towards inventive and progressive teaching. The first major impact this course had on my perspectives of education was my initial exposure to the Common Core Standards of Mathematical Practice. The Common Core content standards encompass exactly what their name implies - the content every student should learn and master. These standards begin with words like "construct," "interpret," "compare," "describe," and "understand," and specify the specific knowledge which students should master and be able to use to solve problems. Notable in the standards is that no teaching method or curriculum is prescribed, only the knowledge that must be acquired.

> CCSS.MATH.CONTENT.8.G.A.3

> Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.

The Standards of Mathematical Practice are unique, in that they are not content-specific, and with this counter the question of “When am I ever going to use this?” Any given student may never need to be able to “Describe the effect of dilations, translations, rotations, and reflections on two-dimensional figures using coordinates.” All students, however, will likely use the skills developed within the Standards of Mathematical Practice in their lifetime, to say nothing of their regular, everyday life. Even if a student is not in the Science, Technology, Engineering, and Mathematics (STEM) field, they will inevitably need to make sense of “problems” and persevere in creating and applying a method to “solve” them. In any profession (and kitchen!), it is important to be able to identify appropriate tools for a given task, and constructing viable arguments with justification with the ability to understand, clarify, and critique others’ reasoning is foundational to a democratic society, and a skill which is supported by the learning of math.

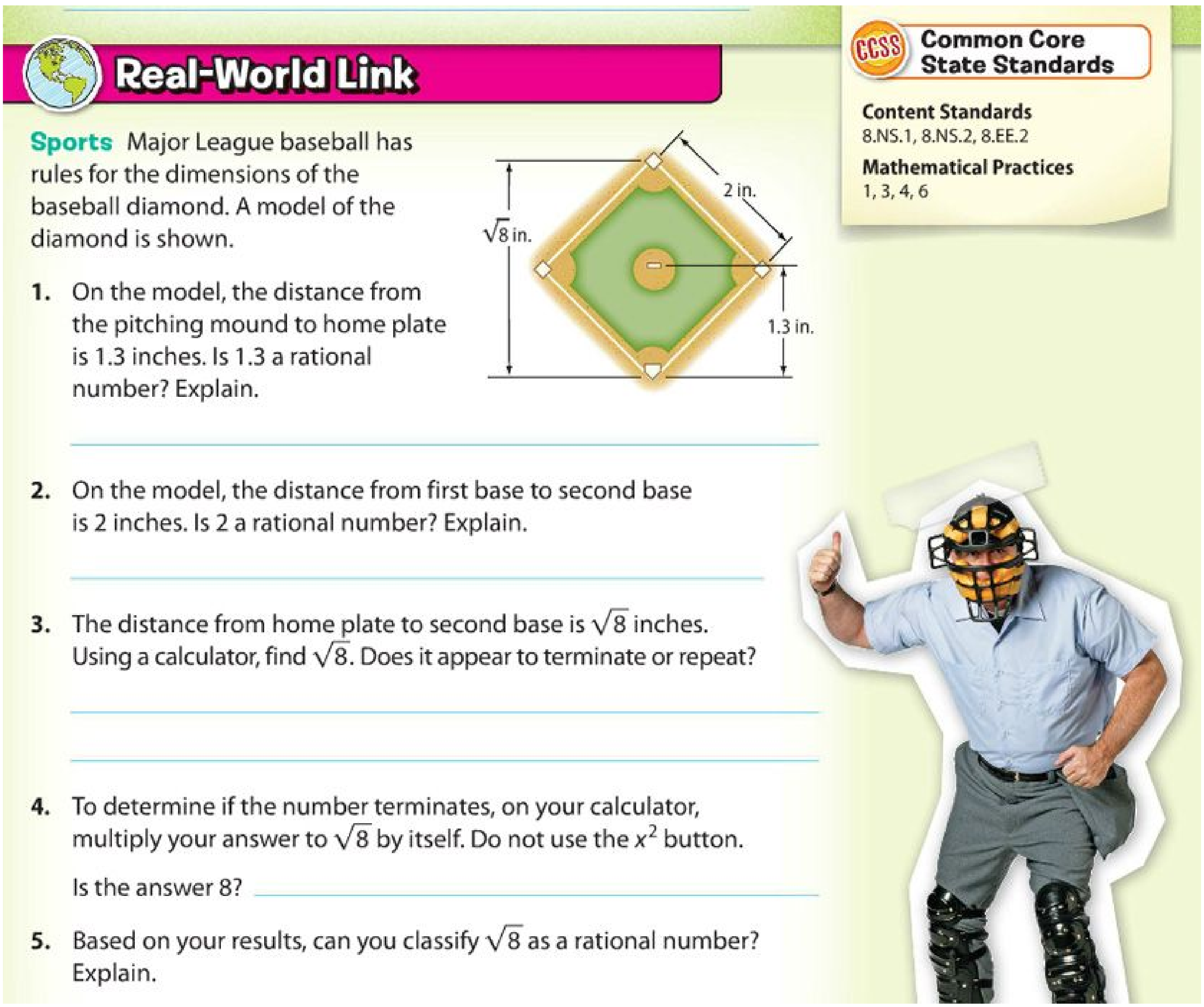
> CCSS.MATH.PRACTICE.MP1 - Make sense of problems and persevere in solving them.
>
> CCSS.MATH.PRACTICE.MP2 - Reason abstractly and quantitatively.
>
> CCSS.MATH.PRACTICE.MP3 - Construct viable arguments and critique the reasoning of others.
>
> CCSS.MATH.PRACTICE.MP4 - Model with mathematics.
>
> CCSS.MATH.PRACTICE.MP5 - Use appropriate tools strategically.
>
> CCSS.MATH.PRACTICE.MP6 - Attend to precision.
>
> CCSS.MATH.PRACTICE.MP7 - Look for and make sure of structure.
>
> CCSS.MATH.PRACTICE.MP8 - Look for and express regularity in repeated reasoning.

Until this initial exposure, I was aware of identifying patterns, modeling real-world situations, and applying structure of expressions and equations as mathematical problem-solving skills, but I had hardly thought of them as part of the content of a mathematics classroom. These practices shift the image of mathematics as grounded in procedures and rote memorization towards something which is living, breathing, and applicable to the real world. The Standards of Mathematical Practice also present an image of mathematics which is far closer to the authentic work of mathematicians than traditional school mathematics.

Through this course, we developed and conducted “teaching experiments”, experimental lessons used to assess students' mathematical understanding and make instructional decisions. For each of these experiments, I designed lessons in which students applied divergent thinking to create their own problems, connected mathematical representations, and interpret and complete one another’s work. Through these experiments, I learned to push the boundaries of my own mathematics learning experiences towards creativity, collaboration, and questioning.

These courses also gave me the opportunity to participate in “lesson study,” a project in which I partnered with fellow teacher interns to collaboratively develop a high cognitive demand lesson over the course of a year. Through this experience, I gained a wider understanding of the roles of collaboration and teacher-observation in education. This is an experience which I have now carried over into my career, participating in both teacher-observation within my school as well as a multi-school lesson study exploring methods for supporting students in creating arguments and critiquing others' arguments (Standard of Mathematical Practice 3), including technology, information gap structures, and games.

These themes of lesson study and cognitive demand were extended in TE 857 - Teaching and Learning Mathematical Problem Solving. This course began with an exploration of the connections (and differences) between mathematical modeling, problem solving, and "doing mathematics." Too often, I saw, mathematical modeling (one of the Standards of Mathematical Practice) becomes reduced to "word problems" at the end of each section in the textbook, in which students work through progressively more difficult problems in a single skill, then apply exactly that same skill to the "modeling" problem. Consider Robert Kaplinsky's example from a middle school math textbook. In the first image, he shows the textbook page as printed; in the next, his only edit is to remove the context. From this, it is apparent to see that the context was irrelevant to solving the problem, functioning at most as an obstacle. Why is this a question that a baseball player, coach, or stadium designer would care about? (It isn't!)



Real-World Link

Sports Major League baseball has rules for the dimensions of the baseball diamond. A model of the diamond is shown.

1. On the model, the distance from the pitching mound to home plate is 1.3 inches. Is 1.3 a rational number? Explain.

2. On the model, the distance from first base to second base is 2 inches. Is 2 a rational number? Explain.

3. The distance from home plate to second base is $\sqrt{8}$ inches. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

4. To determine if the number terminates, on your calculator, multiply your answer to $\sqrt{8}$ by itself. Do not use the x^2 button.

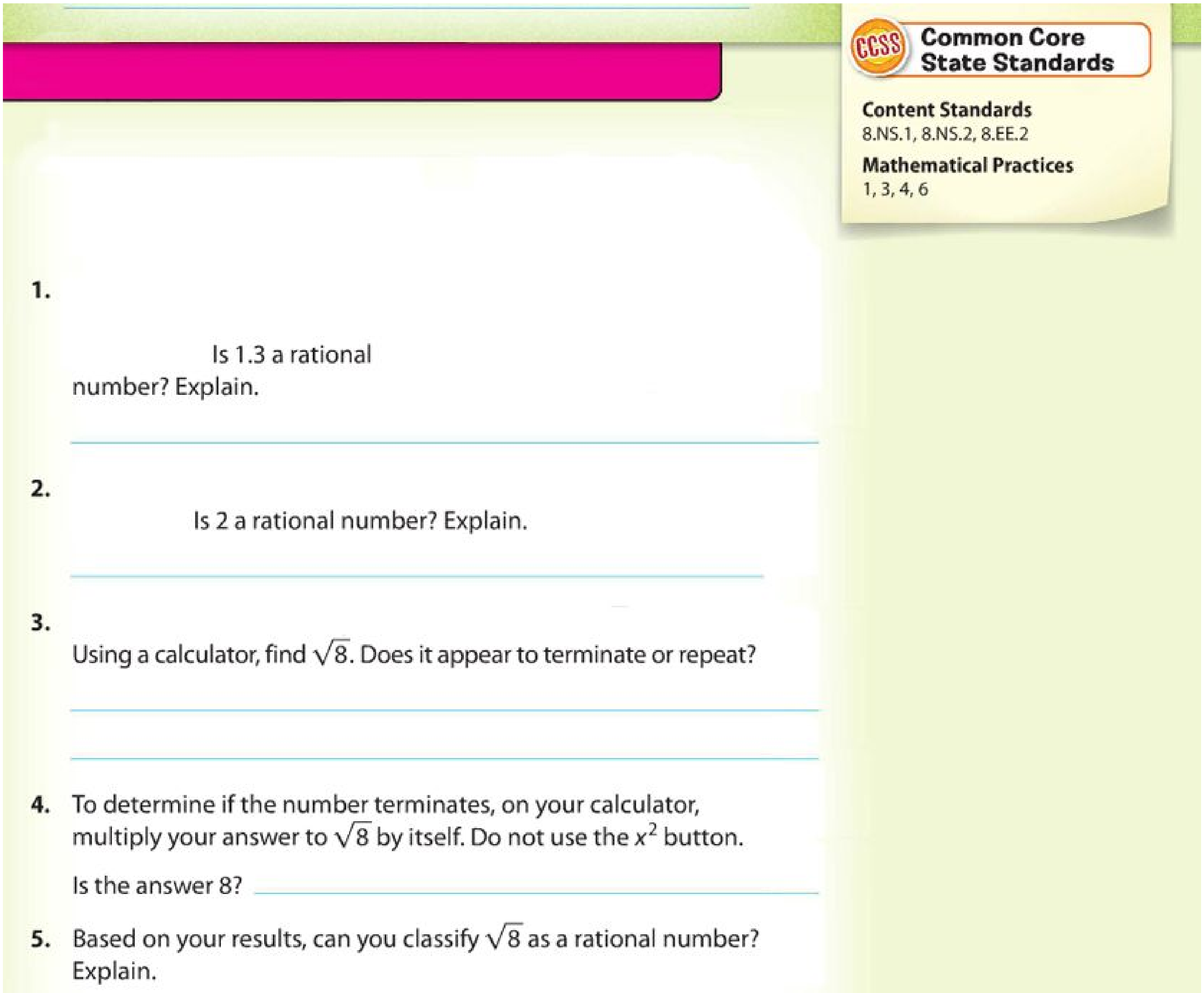
   Is the answer 8? ______

5. Based on your results, can you classify $\sqrt{8}$ as a rational number? Explain.

CCSS **Common Core State Standards**

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6



Common Core State Standards

Content Standards
8.NS.1, 8.NS.2, 8.EE.2

Mathematical Practices
1, 3, 4, 6

1. Is 1.3 a rational number? Explain.

2. Is 2 a rational number? Explain.

3. Using a calculator, find $\sqrt{8}$. Does it appear to terminate or repeat?

4. To determine if the number terminates, on your calculator, multiply your answer to $\sqrt{8}$ by itself. Do not use the x^2 button.

   Is the answer 8?

5. Based on your results, can you classify $\sqrt{8}$ as a rational number? Explain.

As a math teacher, this is an obstacle I have encountered across a number of textbooks and curriculums, which are similarly lacking in authentic problem-solving tasks, in turn depriving students of meaningful experiences of "doing mathematics." The concept of cognitive demand differentiates between these textbook-style problems (which generally fall into the categories of "memorization" and "procedures without connections"), and the types of tasks which support student growth in connecting concepts, representations, and experiences (thus named "procedures with connections" and "doing mathematics"). Through this course, I was given the opportunity to both makeover existing tasks (as in Dan Meyer's Makeover Monday blog posts) and design my own tasks with applications to real world issues that interest my students.

Another aspect of this course which I am working to carry into my career is the design of tasks to facilitate the use of multiple representations. Such design, I learned, not only enrichens whole class discussions, but also widens the entry points into the task and supports the first Standard for Mathematical Practice, "Make sense of problems and persevere in solving them." Drawing pictures, creating tables, graphs, equations, and verbal descriptions creates opportunities for students to share unique perspectives and better communicate their thinking in order to support class-wide conceptual understanding. This cooperatively developed understanding of connections among mathematical concepts is not only useful for supporting short-term student success in math, but also the long-term applicability of problem-solving skills outside the classroom.

Math occupies a position in the educational careers of many students as a gatekeeper, both in high school and college as a requirement for graduation. By "remixing" tasks to include meaningful, culturally relevant contexts and development of authentic, applicable problem-solving skills, I can help to lower or remove this barrier to education and careers, while maintaining the integrity and necessity of learning math. My coursework in EAD 822 - Engaging Diverse Students and Families extended this thinking about cultural relevance and teaching in such a way that is accessible and appropriate to students from diverse backgrounds. In this course, I studied the unique positionings of Black, Hispanic, Asian, Native, Pacific Islander, and White students and families in the American educational system.

One of the topics I found most interesting were the often unseen subcategories of Asian migrants to the United States. Asian migrants to the United States often have the image of a "model minority," which is highly educated, financially well-off, and migrated by choice. Statistically, Asian-Americans as a whole have a similar level of education to the American average, with just under 20% possessing less than a high school education (according to the 2000 U.S. Census). When considering only South and East Asian Americans (primarily with origins in India, China, and Japan), this average drops closer to 12%. However, when considering Southeast Asian-Americans (including Cambodian, Hmong, Lao, and Vietnamese-Americans), the proportion of migrants with less than a high school education soars to almost one-half. This model minority stereotype is particularly harmful to this subgroup of Asian-Americans, who are far more likely to have immigrated to the United States as refugees, to have been deprived of access to educational opportunities, and to live in low-income communities upon arrival into the United States. The stereotype that all Asian-Americans are well-educated leads to these students systematically not receiving the support needed to be successful in school.

On a wider scale, this course supported my understanding of the differences in how cultures interact with schooling. Again, as with the model minority stereotype, assumptions of needs and expectations prove harmful for teacher-family relationships and student success. Differences in culture often result in differences in levels of family engagement with the school – such as in advocacy for student needs and participation in parent-teacher conferences – that do not necessarily reflect the importance that these families place on education. A family from a culture/race that has been systematically disenfranchised from the American education system may be unlikely to directly challenge a teacher's statements on the child's behavior or aptitude for a number of reasons – including a fear of being perceived as aggressive or a lack of awareness that challenging teacher decisions is an option. On the other side, teachers who lack cultural awareness training and experience are likely to have biases that subconsciously influence their treatment of these students, with the potential for significant long-term damage to the child's educational prospects.

The MAED program has widened the horizons of what I understand to be effective teaching. My views of the subjects I teach and the families and students I serve have grown along with my awareness of the potential of what effective teaching can be and how it can shape not only the ability of students but also have far-reaching implications into their lives. Through this program, my future learning goals have shifted and grown to be (1) expand equitable access and engagement in mathematics, as there is no such thing as a "math brain," (2) teach math with social justice applications, and (3) develop and use authentic problem-solving tasks.