Draft of October 5, 2021, 5 p.m.

Script: All Odd Numbers Are Prime (14-student Cedars version)

We will need a big whiteboard and 6 little lapboards. Numbers should be prewritten.

Amos Ewer: We're going to tell you a joke. But this is a math joke, so you need some explanation first.

Briley White *(with lapboard):* A prime number is a number bigger than 1 that is evenly divisible only by itself and 1.

Thus, 2 is prime, because it can only be divided by 1 and 2.

Tabitha Currell *(with lapboard)*: 3 is prime, because it can only be divided by 1 and 3.

4 is NOT prime, because it can be divided by not only 1 and 4, but also 2 and 2.

Chloe Bailey *(with lapboard):* 5 is prime, because it can only be divided by 1 and 5.

6 is NOT prime, because it can be divided by not only 1 and 6, but also by 3 and 2.

Lauren Cochran *(with lapboard):* 7 is prime, because it can only be divided by 1 and 7.

8 is NOT prime, because it can be divided by not only 1 and 8, but also by 4 and 2.

Abrielle Weeks *(with lapboard):* 9 is NOT prime, because it can be divided by not only 1 and 9, but also by 3 and 3.

10 is NOT prime, because it can be divided by not only 1 and 10, but also by 5 and 2.

Amos Ewer: To understand this joke, you also need to know something about different kinds of people.

Levi Moyer: Engineers are known for being satisfied with equations that are only approximately true, not exactly true.

Elijah Baker: Physicists are known for thinking a lot about how precisely their instruments measure things.

Olivia Spaetti: Mathematicians are known for being very proud of how exact and rigorous they are but for making mistakes anyway.

Elijah Knipp: Psychologists are known for pressuring subordinates to make up data and then publishing false results.

Olivet Killingsworth: Sociologists are known for being bad at math.

Noah Bailey: Lawyers are known for high fees.

Lauren Cochran: Grievance studies professors are known for being even worse at math than sociologists.

Abrielle Weeks: All of these are stereotypes. Whether the stereotypes have any truth in them, you must judge for yourself.

Amos Ewer: Now you are ready for the joke.

An engineer, a physicist, a mathematician, a psychologist, a sociologist, a lawyer, and a grievance studies professor walked into a bar. A janitor was sitting there, and he offered to buy a beer for whoever had the best proof that all odd numbers above 1 are prime.

The engineer said:

Levi Moyer: "3's a prime, 5's a prime, 7's a prime--- so all odd numbers are prime."

Amos Ewer: The physicist said:

Elijah Baker: "3's a prime, 5's a prime, 7's a prime, 9's not a prime --hmmm, but let's go on---11's a prime, 13's a prime--- 9 must have been measurement error."

Amos Ewer: The mathematician said:

Olivia Spaetti: "3's a prime, 5's a prime, 7's a prime. By induction, all odd numbers are prime. Quod erat demonstrandum."

Amos Ewer: The psychologist said:

Elijah Knipp: "I forget--- was it odd numbers you wanted, or even? Anyway, I'll tell my research assistant and he'll come back with the right results."

Amos Ewer: The sociologist said:

Olivet Killingsworth: "1's a prime, 3's a prime, 5's a prime, 7's a prime, 9's a prime..."

Amos Ewer: The lawyer said:

Noah Bailey: "First of all, my billing rate is $400/hour, $100 for each 15-minute increment..."

Amos Ewer: The grievance studies professor said:

Lauren Cochran: "What's a prime number?"

Amos Ewer: That's the end of the joke, but like so many good jokes, this one has a moral.

The moral is, just because a pattern works for a while doesn't mean it works forever. There's a famous example of this in math.

Bayly Ummel (*at the whiteboard)*: The 1919 Polya Conjecture by George Polya, author of the famous book *How To Solve It*, is that over half the numbers less than any number N have an odd number of prime factors.

Olivia Spaetti *(with lapboard)*: When Mr. Rasmusen told Professor Connell about the Polya Conjecture, he found it fascinating and wrote Python computer code to check N = 10,000,000. He found that 5,000,421 of the numbers less than ten million, which is over half of them, have an odd number of prime factors. So the Polya Conjecture is true for the first ten million numbers.

Elijah Knipp *(with lapboard)*: But the Polya Conjecture is false. It isn't true that all numbers fit Polya's idea. He guessed wrong. Professor Haselgrove disproved it in 1958. Professor Lehman found the first explicit counterexample in 1960: N = 906,180,359. The smallest counterexample is N = 906,150,257, found by Professor Tanaka in 1980. *(first number written on the front of the lapboard, second number on the back; hide both from audience until you say them)*

Lauren Cochran: So until it's worked at least 900 million times, don't trust a pattern. In math, only proofs can be trusted—and we often get those wrong too.