**“Episode 12. How to Do Math”**

Transcript

Introduction

Sheila: So what makes math so different from other subjects?

Charlie: Well, it can feel different.

Sheila: That feeling is real. That struggle is real. But, it doesn't mean that you can't do it. It's actually part of the learning experience - even for the experts.

Charlie: Yeah, and math can also look different. You know, it can almost be scary to some people. Almost like a language. And if it is this language, then it's going to be a language of discovery… of finding the unknown.

Sheila: So, you're looking for something. Maybe think of it as a journey or a quest.

Charlie: A quest for what?

Sheila: The "Why?"

Charlie: The what?

Sheila: The "Why?" That's the concept behind solving these problems. It's more than just finding the solution for one problem. It's about how you get there.

Charlie: Yeah, and even the tricky ones. You know, the weird ones. The ones that are on a test that don't look like anything that you practiced in your homework.

Sheila: Right. So let's take a look at how to find the "Why?" - in three places.

1. In Class

Charlie: So when you're taking notes in a lecture, it could be tempting to just write down what you see on the board.

Sheila: Yeah, it's the instructor's thinking. It's their explanations, their answers to the questions, "Why did we do it this way?" or "How did we know how to do that?" And that part might not be on the board. It might just be in what they say.

Charlie: Exactly, so it's the explanations, the thinking. It's the finding answers to the how and the why that you want to focus on when you're taking notes in class. Take a look!

Demo 1

Emily: So, now our job is to represent B and O inside of this rectangle because inside of this rectangle is going to represent all of the students at IU.

So, we'll start by drawing this set B. We'll represent it as a circle. So, we need to draw this circle B like this because we need a region outside of B that would represent the set of students at IU who don't want to major in business.

We'll draw the set O like this: the set of IU students who live out-of-state. We need to draw it so it has some overlap with B but isn't completely overlapped with B. Here's why: this middle region would be a student who can major in business and who lives out-of-state, and that can definitely happen, that's possible. But this region right here represents out-of-state students who don't want to major in business. There can be students who want to major in business and live out-of-state. And there can also be out-of-state students who don't want to major in business.

2. In the Textbook

Sheila: Reading math textbooks is not like other reading. The information is tightly packed. Every word and every example count.

Charlie: Exactly. So, instead of just simply reading it, like this, you may have to read it like this and go back and forth with pencil and paper in hand. Defining new concepts and terms through your own words to better check for your understanding.

Sheila: Yeah, you have to work through the examples yourself to really look for the "Why?". It might even help to draw out the concepts and examples to get a clearer picture of the thought that goes behind them. So reading a math textbook might look a lot less like this and more like that. Check it out.

Demo 2

Emily: OK, so my goal is to try to figure out what's going on in this paragraph. OK, so Figure 1.4. "Venn diagrams provide us with a geometric way to represent the decomposition of a set into subsets." OK, so decomposition means breaking things apart. "For example, in Figure 1.4 we illustrate how the set A can be decomposed into subsets A ∩ B."

OK, so Figure 1.4. So, I'm decomposing A, so I'll make A stand out a little bit. I know from class, intersection means "and". OK. And they said A intersect B, the football-shaped region. So here, they have that pointing to this middle region. Looks like a football. So these are things that live in A AND live in B.

3. In the Problems

Charlie: So now we're looking for the "Why?" in your math problems. But you're not going to find it here in the answers.

Sheila: That's why your instructor might not be crazy excited when you get the answer right to, say, problem number eleven. It's because the "Why?" goes beyond any one problem or one solution.

Charlie: It's in the way you get there. The process of working through a problem and the tools that you learn to use throughout the way.

Sheila: The only thing is, you might run into what feels like a sort of weird paradox when you're working on the problems. It's that you learn the most at the very edge of your learning ability. So that means that learning new information can feel uncomfortable, or frustrating, or might even feel impossible.

Charlie: And yet it's in this same place where the sweet spot for growth is. But, how do you get there? How do you get past these feelings to where the real learning takes place?

Sheila: Well, you build a problem-solving system with several key parts. First, you take the problem apart. You break it down and you analyze it. You can ask some questions.

Charlie: Like, "What kind of problem is this?" What tools, strategies, concepts, and equations will you need to use to solve it? What are the steps and how do you know?

Sheila: Second, you follow them and as you go, lean into the struggle. It's OK. It's part of it.

Charlie: And finally, you check your work. Did you get it right? And if not, what happened? Analyze your mistakes. Did you find the "Why?" If there was another problem like it that looked a little different, could you solve it?

Sheila: Now that is what leads to true understanding. It changes your brain. Because every time you do this, you're creating more and more robust neural connections. The ones that you'll need to nail these problems.

Charlie: In his book *The Talent Code*, this is what Daniel Coyle refers to as deep practice. It's how you get better. It's how you get good. Let's see this at work.

Demo 3

Emily: OK, so this says Z lives in (oh gosh) A intersect B complement union C. OK, so I have no other way to do this except to break it down. So the first thing I'm going to see is I’m going to break this up into the two different sides of the union sign. I'm going to try to do this side first because for unions you only have to satisfy one of the sides to get in. So, if Z is in this side then I don't even have to worry about this thing, so I'll try that first. So, does Z live in C? I look over here… it doesn't! So I'm not lucky! So I do need to check this thing on the other side to see if it's in there or not, so let's see what this is. A intersect B - this is going to get shaded in. So, A intersect B is anything that's in A and in B. But this is the complement of that, so it's anything on the outside of that green. Well, Z lives in here so it can't live in the complement. OK. So Z also isn't in this region. Z doesn't satisfy either thing on either side so this one is also False.

To Review

Sheila: To find the "Why?" in class, try taking notes on the instructor's thinking and explanations - instead of just copying what you see.

Charlie: To find the "Why?" in the textbook, give this a shot. Read it like you need it. Like every word counts. Work through examples with pencil and paper and seek understanding.

Sheila: And to find it in the problems - well, you'll need the answer, too - but you'll find the "Why?" in the process of how you got there.

Charlie: And if you remember nothing else from this video, remember this: keep going! You can do this. And we'll see you on the other side.

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