

Big Picture Podcast - Episode01

Introduction / How to Study Effectively

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Tracy: Welcome to Chem 101. The big picture podcast with your hosts John and Tracy Suchocki.

John: We're here as your expert tutors helping you to learn the concepts of chemistry and to recognize how these remarkable concepts apply to modern living

Tracy: And of course there's a deeper story which is that the very process of learning chemistry holds many benefits including improved thinking skills and because we learn best when we learn together improve social skills too.

John: All of this we call the big picture. You can think of this podcast as your personal coach. We're here for your support as you journey into the big picture.

Tracy and John: At your service.

John: This is the Chem 101 big picture podcast. So glad to have you on board. Welcome to this first episode of Chem 101 picture podcast. My name is John Suchocki

Tracy: And I'm Tracy Suchocki who is this podcast for.

John: Everyone who wouldn't be interested in atoms and molecules. Exactly.

Tracy: Okay.

John: And if you happen to be a student who's taking a chemistry course right now you might find this particularly useful.

Tracy: Excellent. So for chemistry students as well as lifelong learners. Here you go.

John: Okay great. All right. Goals

Tracy: Well

John:

Tracy:

John:

Tracy:

John:

Tracy:

John: The goals of this podcast.

Tracy: The first one is gonna be to learn the chemistry.

John: All right. We'll do that. We'll go into the nitty gritty will also go into just the broad brush stroke. Mean ideas as well. It'll be, it'll be a review of the basic concepts of chemistry we'll go into the atomic nucleus and two chemical bonding into molecular interactions.

Tracy: Stoichiometry?

John: Yeah okay. We'll do some stoichiometry too. All in the interest of understanding the nature of this universe from the perspective of atoms and molecules.

Tracy: Okay so then the second goal is applications of chemistry.

John: What do we mean by that?

Tracy: Well what. How are we seeing chemistry in the world around us in our everyday life.

John: All right. So there you are in the grocery store and you see the food. It says non GMO.

Tracy: What's that mean?

John: There you go. Application.

Tracy: It's bad. This is

John: No no no.

Tracy: Good.

John: We got to understand what a genetically modified organism is. Then you can make your decision of whether you want to make that purchase or not. Right? So that's the idea of the application of chemistry. Chemistry is indeed all around us especially in this modern age and there's an argument to be made that the chemistry made much of this modern age for good or for bad. Look around you most everything you're dealing with is made from chemistry. The food you eat the clothes you wear.

Tracy: So when we know more about the chemistry behind the products we're using are behind the food we're eating or the medicine we're taking than we can know the long term effects of our decisions.

John: It's important that our decisions be informed. I saw a video the other day on micro fibers that was fascinating. You know the issue of plastics going to our oceans right. Yeah. So where do most of those plastics come from?

Tracy: Our water bottles?

John: Well what it was pointing out was is actually coming from the micro fibers acrylic and poly Esters within our clothing.

Tracy: You mean even those cool new fleece jackets that we all wear

John: Especially

Tracy: Winter only

John: Those cool fleece jackets. Okay so you know your the dryer up a lot of that lint. But what happens to any lint that the washing machine.

Tracy: I wish we could figure out a use for that

John: For the lint?

Tracy: Land. Here

John: Oh

Tracy: You go.

John: There you go. There's your next home project.

John: But I was pointing out how those microfibers actually go right down the drain from the washing machine and go in from the drain goes to the river from the rivers go to the ocean goes into the plankton building up into the food chain and right back to us.

Tracy: So

John: It's all it's all connected is the point. And so when you're looking at the world from the perspective of atoms and molecules that lends a lot of insight that's pretty darn important in terms of motivation even

Tracy: So applications of

John: Chemistry that I gotta say it it's more than just the application of chemistry. I would emphasize the insight that we get from chemistry to.

Tracy: Insight can you say more on that.

John: Sure. Okay imagine water from a chemist point of view they they think of the molecules of water and we'll be talking about what we mean by a molecule of water. But for now just hold up your fist.

Tracy: Yeah.

John: Hold up your other fist. Okay

Tracy: Okay

John: Everyone out there ourselves here we're holding up our fists right

Tracy: All right.

John: Tight

Tracy: Take

John: Fist

Tracy: This.

John: Each fist represents say a water molecule. So how many water molecules are you holding up

Tracy: I have

John: To. OK right now if you have water vapor you have water molecules that aren't actually touching each other but they're moving around wildly occasionally colliding but on average far apart from each other now don't hurt anybody around you but move them wildly around your head. Ouch.

Tracy: Okay

John: And

Tracy: What

John: You're representing there are water molecules in the gaseous phase where each fist represents a water molecule a fundamental particle of water So you wanna know where I'm going with this.

Tracy: Yes I do.

John: Okay okay go ahead and shake your fist around freeze time all right. So your fists are are frozen still because time has frozen. Right. It's still a vapor phase. Okay so now you're looking at your two fists. Once a water molecule the other is a water molecule. Here's the question what's in between those two fists.

Tracy: I have no idea.

John: Is that A air is it B water. Is it C nothing?

Tracy: It has to be nothing.

John: It's nothing it's absolutely nothing. A lot of students that I think well that must be air in between. No no no. We're looking at the world from atoms and molecules down at that level. If there were air in between those two fists you'd see it as another fist of maybe a different color or something. And so the insight you get here is that in between

those two water molecules there's nothing nothing to breathe. The vacuum of space the Starship Enterprise if it were small enough would go zipping through. Think of it, if all is particles then what's that mean. It means there's nothing in between those particles. It's hard to conceive but simpler to simply say maybe atoms don't exist or or they're imaginary. And you know this held back the discovery of the atom. I dare say centuries and it was the discovery of the atom that was one of the most important ever. Don't believe that just compare today's standard of living to that of say a thousand years ago. And why has the human population boomed only so very recently. We discovered the atom.

Tracy: Fascinating.

John: But I had a student. She came up to me at the end of the semester one year and she said "Coach you know I'm never going to forget that in between two water molecules is the vacuum of space." Nothing is there. So the idea is when you look at the rain the rain falling down in the thunderstorm you have such a different perspective. The number of raindrops in that thunderstorm is a lot.

Tracy: Yes yes.

John: Yeah.

Tracy: Huge.

John: Yeah that but

Tracy: The.

John: That number of raindrops is so small compared to the number of water molecules in one of those raindrops. That's an incredible

Tracy: Incredible

John: Perspective.

Tracy: That's

John: Amazing right. So it's it's more philosophical but come on.

Tracy: Well it's it's trying to grasp at new ideas expand our minds and have a different perspective than just maybe what's immediately in front of us at face value. We're looking deeper

John: Insight.

Tracy: Inside

John: Yeah.

Tracy: Insight.

John: So when we talk about application in chemistry there's the the daily stuff like your laundry but there's also the plain philosophical stuff when you're looking at your natural universe surrounding you. There's a lot to see

Tracy: When we can appreciate our world so much more. I mean that's exciting.

John: Not that we. Not that we don't already. But I would argue that a rose garden is beautiful to anyone But if you're a botanist when you walk through that Rose Garden you're seeing the relationship between the flowers and the insects. How it is the bees are looking at the flowers with ultraviolet light and you're seeing the relationships the intricacy the level of beauty just gets better.

Tracy: All right. So it's all about our relationship with our world.

John: So our goals. One chemistry to.

Tracy: Application of chemistry

John: With

Tracy: In

John: A bit

Tracy: Science.

John: Of insight and then

Tracy: Three back story. We want to talk about the back story of chemistry.

John: Which is what you mean by BackStory.

Tracy: When we talk about back story we're talking about all the things that we learn while we're learning chemistry

John: How we learn while we're learning some.

Tracy: Yeah. So how to learn analytical thinking we're using analytical thinking skills when we learn we're using social skills we're learning from each other. We can solve problems and ask questions.

John: I would argue all that has value.

Tracy: I think so.

John: Understand we'll be going into the chemistry that's for sure. But you could also think of the chemistry as a vehicle to higher goals here. You're learning not just about the chemistry.

Tracy: You're learning about yourself.

John: Yeah and how to work with others. You might call it Alba the Metta stuff outside of the chemistry itself that which you learn while you're learning the chemistry. Watch for

that carefully. It's important. It's why people come together for a class. I mean if you want to learn just the content of chemistry why not just watch it on a YouTube channel.

Tracy: You could do that but then you'd be missing out on hearing other points of view and being able to ask questions and hear answers and

John: That's what we're talking about in terms of the backstory all the stuff that you pick up as you're picking up the chemistry

Tracy: Excellent. Well so what's the structure of these podcasts.

John: Okay. So the goals are the chemistry applications that chemistry and this weird thing we're talking about called the backstory and the structure of each podcast. We were thinking we should actually start out with the back story and then after the backstory will go into a segment called do the review

Tracy: All right so let's talk about the backstory for a second how are we going to get into the backstory for each episode.

John: Well we'll have interviews with interesting people.

Tracy: Awesome

John: Some will talk about learning techniques specific techniques that will help you do much better on your exams if that's your interest. These are life skills that will be with you well beyond the chemistry course.

Tracy: Mm hmm. OK.

John: And do the review.

Tracy: All right. Do the reviews. So in each episode we're gonna go over each chapter.

John: So this is the first episode we'll be going over the first chapter of the textbook for this course which is conceptual chemistry.

Tracy: Which additions are you using

John: And the fifth edition that I want to make note that you're not using conceptual chemistry if you're using another textbook that's fine. You should find this applicable.

Tracy: Ok.

John: And so it's the do the review we'll be going over the main ideas chemistry and into the nitty gritty as well.

Tracy: All right. Quick question if you don't have a textbook what can you do. All right you go to the library. Oh if

John: Could could

Tracy: You

John: Go to the library

Tracy: Less likely they'll have a copy at your college library or you can try your public library as well.

John: Conceptual academy of course has the videos or we should say something about that.

Tracy: Ok.

John: The video is different from the textbook. They don't compete with each other they complement each other. The textbook is where you can read the videos where you can watch and listen. I'll have students come up to me and say hey coach the videos are doing so well. Do I need to read the book. And I'm like Just because a format is comfortable for you doesn't mean it's the best learning technique in fact it can be the opposite. Learning is not about comfort. And when you push yourself. That's that's when you're most effective. So go ahead and try those paragraphs. But what you should find

in the end is that the video provides the context for understanding those dense paragraphs in the textbook. Hey I think we're ready for the backstory.

Tracy: Welcome to the backstory.

John: Of the back story What's today's topic?

Tracy: Today's topic is how to study effectively.

John: Oooo.

Tracy: Hey John how did you learn to study effectively.

John: You mean back when? I'm

John: You've reminded me of the story of Steve.

Tracy: Tell me the story of Stevie.

John: Steve. OK. You know all through high school. No one. I I don't think anyone ever sat down with me or my classmates to teach us how to study effectively. I think they just assumed. Well you got a brain you'll be able to absorb this information and spit it back out on the exam right. So there I am in college. And I found my most effective way of studying was to listen to music while I was studying.

Tracy: Okay.

John: So I would have my headphones on and I would open up my organic chemistry textbook and I would study and then one day my roommate Steve came up to me and said John I said you know what is it. Why are you listening To your headphones to music while you're studying. And I proudly explained to Steve well because if I listen to the music I can study longer.

Tracy: Mm hmm.

John: Well he looked at me and said Well John because you listen to the music you have to study longer. And I was like Oh no I mean no one ever told me that before something to that really basic. So I stopped listening to music while I was studying and lone behold I didn't have to study as long which meant I could study other things which meant I was more effective which meant my bees actually started turning into 80s.

Tracy: Awesome. So there are actually ways to study effectively than most

John: Not

Tracy: Of us.

John: By listening to music

Tracy: Right. But most of us will be reading a textbook over and over again trying to memorize it trying to integrate or trying to

John: Get

Tracy: Make it.

John: Them. So what do we do now. Yeah. That's a mistake. You should read the textbook you like this but once. No way.

Tracy: No way. I

John: Yeah.

Tracy: Would never

John: No no you

Tracy: I would never

John: But

Tracy: Get

John: Once

Tracy: A

John: But

Tracy: Book.

John: Once and move on. We'll talk about that but the main thing here is this there's this wonderful book called make it stick by Peter Brown and others. It's how we will put that in the show notes so you can have a reference to it.

Tracy: That's an amazing book.

John: It's not that long of a book either but it goes into the cognitive science from the past 10 15 years. We have learned a lot about how we learn and this beautiful book called make it stick goes into how to learn effectively and a lot of it is actually counterintuitive like I would think listening to music would be an effective way to learn but it's not. And it's this book I wish I only wish I had it when I was just starting my academic career.

Tracy: Do you think this would be a good book for lifelong learners to read.

John: It's a good book for for everyone especially in this 21st century where it's all about being able to learn and integrate ideas

Tracy: All right. Well tell us about it.

John: Ok. So I was thinking this is something my students have to read in question do. Do I make it a requirement. This is for this chemistry course and I was so close to actually doing that that I thought even if I did how many would actually read it. So I condensed it down to 17 pages.

Tracy: Thank you.

John: As the review the main points of this book and if this article that I wrote the 17 page article encourages you to read the book that I have succeeded in my mission with that article. This article is available to you within the first F page of each of conceptual academy course and also available to you at conceptual science dot com in our show notes.

Tracy: Can you describe a little bit about how we learn.

John: Within that essay and giving a synopsis of the make it stick book. However I've also interjected my own experience with what I call step 1 step 2 learning which would be important to present here.

Tracy: Okay so step one step to learning what's that.

John: Okay. Step 1 learning is where you are inputting information.

Tracy: Okay.

John: Step 2 is attempting to output that information you input the information step 1 and then you try to output the information in step 2. So we call that step 1 step 2 learning.

Tracy: Got it. Okay so step one is where we're taking the information in maybe at a lecture.

John: A textbook video and notice during step 1 Your mouth is typically shut you're absorbing information you might have a blank expression on your face you're working hard on absorbing information

Tracy: You're listening.

John: Yes and it's important in step 2 is where you try to articulate that which you think you learned from step 1

Tracy: That sounds challenging. How do you do that.

John: You actually have to open your mouth or pick up a pen you have to output and of those two steps. Guess which ones a little bit easier

Tracy: Well it's like watching a movie you can just sit back and watch or listen or read.

John: And actually producing that movie his step too so step one is absorbing the information. Step two is outputting the information and absorbing information is its passive step to outputting the information is active. OK guess what homework is.

Tracy: Definitely step to

John: Step one may feel comfortable. Step two is anything but step two is a challenge. You might stumble. In fact you probably will. It's so difficult to get yourself to move forward with step 2

Tracy: So some of us really like to be challenged. Sometimes the higher the mountain the more challenging and exciting it is to try it

John: I

Tracy: Serves

John: Think there's that element

Tracy: In

John: All of us right. It comes and goes maybe with

Tracy: The

John: Coffee.

Tracy: Step two sounds like it takes effort it takes concentration it takes energy.

John: Let's think of a beautiful lecture. Lectures very clear and interesting. How does it feel when you're walking out of the lecture hall.

Tracy: While you feel like you just learn something like somebody just told you something so interesting that you were engaged for an hour listening to them

John: You have what I call the warm fuzzy the warm fuzzy it's like I got it. I'm ready for the exam.

Tracy: And that was cool.

John: Yeah it

Tracy: It's

John: Feels so good that you're fooling yourself into thinking that you're ready for the exam. You don't need to study anymore. You don't need to go into step 2 because you got it you think. And that's what I call the warm fuzzy. So after a wonderful beautiful smooth as silk lecture you're gonna get this warm fuzzy and you're gonna get this sense that you don't need to take it to the next level. But here's the point. Could you? After listening to that beautiful lecture go up and give that beautiful lecture yourself.

Tracy: Probably not. You have a good point. They've probably worked really hard on putting that lecture together

John:

Tracy:

John: Which is why the young professor preparing his or her first lecture this is the one who learns the most

Tracy: I remember you going through all that

John: You know going through your notes. How do I present this exactly as you prepare for that first lecture. Man that's a learning curve. You give that first lecture with all good intentions and you blow it. Then you do it again and again and then and only then does it come out smooth as silk

Tracy: So it takes practice. Is that what you're saying

John: It's

Tracy: Is

John: The doing. Let's go let's go to the basketball analogy. So say you've never heard of basketball before. I don't know where you're from but you've never heard basketball before and

Tracy: It

John: You're sitting on the bench and this coach comes up and explains to you how to play basketball

Tracy: Sounds good. Add

John: At a dribble how

Tracy: Had a

John: To make

Tracy: a pass

John: And

Tracy: Had

John: How to shoot the ball

Tracy: Mm hmm. Right. Warm fuzzy.

John: Warm fuzzy and he's really good at describing how to do these things. So do you think you can get on the court and suddenly start playing like LeBron James.

Tracy: Probably not.

John:

Tracy: [laugh].

John: You have to get onto the court and actually do it yourself. So sitting on the bench listening to that coach is

Tracy: Step

John: One going out on the court and actually doing it is.

Tracy: Step two

John: Yeah. Step two is is the doing. And we learn by doing. We all know this. Step one is the introduction. That's important. Don't want to skip it. You need an introduction. Step two. That's also important. That's where you yourself is the one out there doing it giving the lecture during the basketball explaining that which you think you understand from step 1

Tracy: So it's really engaging in the things you're learning. I mean we do that in life all the time.

John: Right. As we learn things then we want to go and try it out here. Give me that ball. I want to go do it then that's totally natural. And it goes back down to

apprenticeship. You would have the master show the student how to do the blacksmithing and then the student went and actually did the blacksmith thing that's step one followed by Step two it's its natural.

Tracy: It's interesting though that you use the mentorship because then it comes back to having a coach or a teacher guide you like to help you improve along the way.

John: Yeah.

Tracy: So you're not

John: You

Tracy: Don't try it out and then become a master that you try it. You make mistakes maybe and then you get redirected by your teacher or mentor

John: So if you're looking at your instructor as someone who is merely there to present information to you there's there's a bigger picture. The instructors also there as a coach to help you learn that information and integrate that information in a way through which you'll find meaning.

Tracy: Okay so maybe ways that you hadn't thought of before.

John: The instructors also there to help you learn about yourselves Yes and how to work with others because as you were challenged out on that court you're learning what your strengths are your weaknesses your exploring what you can do. That's important.

Tracy: That's

John: Interesting. Step one step to learning we'll be talking about that a fair amount through this podcast series because it's important. But back to the. Make it stick. There are specific techniques for learning within that article that we go over we should review those as those as well.

Tracy: Yes they're very interesting

John: Like delayed retrieval enter leaving New monarch's calibration. What's your name.

Tracy: My name.

John: Yeah. What's your name.

Tracy: Come on you know my name.

John: Why

Tracy: Would

John: I know

Tracy: Do

John: Your

Tracy: You

John: Name.

Tracy: Were married

John: But do they know your name.

Tracy: To

John: Wait wait don't tell them. All right listen.

Tracy: Listeners okay.

John: Ok. So I think

Tracy: What's my

John: I think

Tracy: Name.

John: I think earlier we mentioned our names and maybe you remember her name. Maybe you don't remember her name. If you don't remember her name you might be tempted to immediately hit the rewind button and go

Tracy: Rewind.

John: Look at.

Tracy: This is

John: But what

Tracy: Century

John: Or in to

Tracy: Two

John: To

Tracy: Two

John: Go back to the beginning. Let's find out her name or here's a better choice. Try your best to remember her name right now as you do that you're trying to access information that was placed in your brain. It is there. You need to be able to access it. And there's a connection between your working memory and your deep memory that needs to be strengthened and what's a good way to strengthen that connection is to actually try to retrieve that information. The process of trying to retrieve that information

is how you strengthen that connection. Now if you just go back to look up the answer you're not strengthening that connection.

Tracy: Well are you reinforcing that connection right because you're re you're here. You're repeating it. So then you're starting to reinforce it so that you then you can strengthen it.

John: No.

Tracy: That's a miss. Okay. It's

John: No.

Tracy: A misunderstanding.

John: No.

Tracy: No

John: It

Tracy: It's

John: Is best to forget something. Say you. If you want to learn it it's best to forget it. That's counter intuitive. So you have a stack of flashcards. You need to memorize a set of 20 facts.

Tracy: Okay.

John: Should you go through those cards and memorize it. Solid cold.

Tracy: Yes.

John: Or not

Tracy: No.

John: Or should you go through that stack and just memorize it. Pretty good so that it's OK

Tracy: I would go further trying to memorize it solid core. What's wrong with trying to do that.

John: A better approach challenge you to try is to just memorize that sort of good. Put them aside. Come back to it later maybe the next day and try to recall the whole stack. And as you try to recall each individual card you're strengthening the connection between your working memory and your long term memory. Now don't kill yourself if you can't totally remember one of the cards. Sure. Go ahead and look it up but that moment that time that struggle that effort you put out to try to recall that information that's a strengthening of the connection between your working memory and your long term memory. You'll find in the book make it stick refers to that as delayed retrieval so you learn some information. Then there's a delay. Then you try to retrieve that information and delayed retrieval is overlooked as a awesome way to actually learn information.

Tracy: You know now that you mention it I went to a pretty intense conference about a week ago and I it was a lot of input a lot of information and I was worried you know that I wasn't remembering all the information because I was excited to use the things that I had learned and I've been noticing over this past week that the things that I thought I forgot were coming back to me.

John: There was a delay and if you could just relax with it and it's interesting when you have stress that's like the quickest way to choke off your frontal cortex. That's the thing with an exam. It's stressful for the exam then that blocks things off your performance on the exams gonna go down when you can relax with it. Things begin to flow so there you are at that conference. It was an intense conference but you just let it settle and things naturally percolated back up and as they did and as you recalled pieces and information you started using it then it strengthens the connection. Now that's by design the brain's only going to want to remember that which it needs. So if you don't need that information anymore it's just going to naturally float away. That's by design but if it's

information that's of interest to you that you're going to need that you're going to be using. Then you start pulling it back and that's when the connections strengthen

Tracy: Okay. That is counter intuitive. I would want to memorize the flash cards but actually that probably never really works. So we're talking about studying efficiently. That may be inefficient to try to just drill it into our heads.

John: And the same thing with the textbook. Students will want to learn the material cold solid say in a chapter before they attempt to work on say the questions at the back of the book

Tracy: So what do you recommend.

John: Will let you see the students will say How could I possibly answer those questions if I don't understand the the paragraphs yet.

Tracy: Yeah of course that makes sense.

John: But it's

Tracy: Core

John: It's that

Tracy: The.

John: It doesn't it. Absolutely the reverse. You need to ask how can I learn the material if I don't work on the questions. It's the questions that step to that allows you to do the doing.

Tracy: So it's almost like asking yourself OK what do I know about this question from reading the chapter once. What can I what. What do I know. What do I understand.

John: Right. And don't kill yourself. Go back in and refer to the paragraphs as you need to. But an ideal strategy is to read through the chapter but once then go to the questions

at the back of the chapter and start answering those questions you don't need and actually you shouldn't know the material cold solid before you get to the questions. The questions are there to help you formulate the ideas yourself. It's the step to.

Tracy: All right now I'm going to just venture out there to say that actually. Okay so step two is difficult because you're applying your questioning you're digging deep. You may not know you may feel uncertain so it's it's not that comfortable. So it's challenging but on the other hand that's what could make this actually fun because you're actually doing something now you're actually challenging yourself and learning about you know how how you're thinking and

John: You're

Tracy: What

John: Engaged

Tracy: What resources do you have. Yeah I think it's fascinating so that can actually really appeal to those of us that love a challenge.

John: So should you do. I'll step one and then I'll step to

Tracy: No it sounds like you're integrating you're actually breaking it apart and engaging in the different the two steps together. Like mixing them up.

John: We call that

Tracy: Into

John: Inter

Tracy: The

John: Leaving another

Tracy: Mixing

John: To

Tracy: It up

John: Enter.

Tracy: Is entirely.

John: Yeah

Tracy: Also

John: So the basketball coach is gonna show you how to dribble how to pass how to shoot how to do this and how did this and then three on to the court

Tracy: Or give you a little steps to take the time.

John: Right. First we'll show you how to dribble and then you go practice dribbling all right

Tracy: Stable.

John: Step one step two then here she'll show you how to throw a pass

Tracy: All. Right.

John: Then you go

Tracy: Got.

John: And practice the past so

Tracy: You're

John: Getting

Tracy: Drills little

John: You're

Tracy: Drills.

John: Getting drills and you know that's how it works. So step 1 step 2 should be what we say into lead are integrated and it's you know it's going to depend upon the nature of the material some materials pretty darn easy you're gonna have more step one and step two other material like gosh when we get to stoke geometry I can show you how to do the Stoke gamma tree but it's gonna go right past you if you're not actually doing it yourself for that material you're going to need to do a lot more step to learning but what's important is that as you're learning anything is is to look to see what you're doing if you're doing all step one and absolutely no step two that's not going to go very well you need a balance of the two and on top of that the two get integrated with each other and after you sit back and reflect on what you're doing ask yourself the question How much is step one am I doing. How much is step two. Am I doing. And you can guide yourself

Tracy: All right. That sounds that sounds really helpful.

John: Yeah.

Tracy: Think

John: Steve. And thank you. Authors of make it stick. What a wonderful book. Are there other techniques that we can use from the make it stick book. Yes. Yeah. Well delayed retrieval is just one. There's interweaving. We mentioned that there's new monarchs there's there's calibration and a

Tracy: What are those or do we want to know about them.

John: Oh you do want to know about

Tracy: We do.

John: Those.

Tracy: Ok.

John: Yeah. Yeah. And please go to that article this that 17 page article and you can read all about that very useful stuff.

Tracy: I just have one more question. Wondering if this would be helpful to talk about learning from our mistakes

John: I think that's the only way we learn and that's why step two is so important because you're going to make no mistake sitting down and listening to that beautiful lecture you will make plenty of mistakes when you try to give that lecture. We learn from our mistakes which is why I favor what I call an encouragement based homework system. And perhaps we can talk about that in another episode

Tracy: Ok. So this is taking us to the back story again learning about ourselves and I think what you're saying. Well learning about ourselves I think that we can start playing with the idea of becoming more comfortable with making mistakes. So again this is counterintuitive. Like you said earlier that we really try to get things right. We're really hard on ourselves generally. But if we can become more comfortable with making mistakes then we'll be more successful and probably everything we do.

John: That's awesome. So think about it in the classroom. There you are with

Tracy: A

John: Bunch of other students putting yourself out there

Tracy: And

John: Making mistakes. Is it couldn't be better. You're helping not only yourself

Tracy: But

John: You're helping

Tracy: Your

John: Classmates as well. How would you be helping them. You know the student raises their hand and they ask this question

Tracy: You

John: If you get this palpable sigh of relief Thank goodness they asked that question because I had that

Tracy: Same

John: Question

Tracy: Too. And

John: If they try

Tracy: Tried

John: To answer

Tracy: A

John: Question

Tracy: And

John: It's wrong it's it's all good

Tracy: Ok.

John: Because it takes us in the direction it takes a

Tracy: The

John: Whole class

Tracy: In the

John: Direction

Tracy: Of exploring what

John: Did we assume what did we misunderstand

Tracy: And

John: What is it that we're trying to learn. It's like

Tracy: There's no

John: Going backward every everything you do is going to be

Tracy: Forward. That's

John: The back.

Tracy: Story.

John: Haha I think it's time to do the review. All right let's go. Welcome to this segment of the big picture podcast called do the review. This is the time we sit down with a textbook. We'll leaf through the pages providing page by page commentary.

Tracy: Sounds

John: Great. One thing to make it stick. Book talks about is to throw away the highlighter.

Tracy: How come we should

John: Throw away the highlighter the highlighter is there to highlight the most important sentences. The thing is textbook they're so dense every sentence is important. So you'd end up having to highlight every sentence of the whole book.

Tracy: Good point.

John: It defeats the idea of a highlighter. So make it stick. They say throw away your highlighter every sentence is important. And also in terms of reading read slowly for comprehension. This is dense stuff. If you try to fly through it like a novel it's just not going to work. Don't worry that you're not understanding it with great depth right away. That's not supposed to happen. Rather as you read through it you're getting a general introduction. That's step one.

Tracy: Ok. Do you want to read it over and over again.

John: You know as you read a paragraph over and over again you're gonna start mistaking understanding with familiarity. You'll have the familiarity. You'll know what's coming up in the next sentence and all that but that does not mean you actually understand the material so it can be deceiving.

Tracy: Ok so we don't need to read the chapters over and over again.

John: Recommendation read through the paragraphs once. Then move on to the questions at the back of the chapter. And as you struggle with those questions and you should be struggling with us questions refer back to the chapter paragraphs as needed.

Tracy: Okay. That's helpful.

John: Yeah.

Tracy: Yes.

John: So you're going back and forth between the two. And as much time as you're spending on the paragraphs that's about as much time as you should be spending on the on the into chapter questions.

Tracy: Ok. So we're reading slowly so we spend some time on the paragraph and reading and then we practice using the questions in the back of the chapter.

John: Right and go. Remember the 50/50 rule as much time you spend reading is as much time as you should be spending on the questions

Tracy: Pace sounds good.

John: Right. So here we are with Chapter 1. All right let's let's pick up a random page. Okay here we are. Page 11 Okay trace. Go ahead. Let's practice what we preach here. Read a paragraph.

Tracy: Okay.

John: The next thing I'm thinking it's important to point out is the most important question of the mall which is what did I just learn

Tracy: What did I just learn.

John: Exactly as you're reading through the paragraphs. Periodically ask yourself that question. What did I just learn. And then actually answer that question in that way. You don't actually have to go to the questions in the back of the book. You can make up your own question in that own question you make up is what did I just learn. And you keep asking that of yourself repeatedly and you keep answering that repeatedly. And notice when you try to answer that it's not very comfortable you're not gonna want to do it.

Tracy: Okay

John: So

Tracy: Let's

John: Do that.

Tracy: Okay.

John: Shows people how it works

Tracy: All right. So we're gonna pick a random paragraph.

John: This one on facts. Do that one. Okay. It seems germane

Tracy: It is common to think of a fact as something unchanging and absolute. But in science a fact is something agreed upon by a competent observer by competent observer observers as being true. Interestingly what humans accept to be factual changes over time as we learn new ideas. It was once an accepted fact that the universe is unchanging and permanent. Today we recognize the fact that the universe is expanding and evolving

John: Okay

Tracy: So

John: That it's dense isn't it. It's

Tracy: Very dense

John: That was that was at a difficult to read.

Tracy: It

John: Was difficult.

Tracy: To read.

John: Yeah. All right. So now after having read that paragraph the task is to summarize that which you think you just learned

Tracy: Okay so in summary for example it is common to think of a fact as.

John: Stop stop be reading your freaking paragraph again.

Tracy: I know

John: Yeah

Tracy: You're

John: I'm going to close it.

Tracy: Okay

John: Okay but closed

Tracy: Book closed.

John: Would

Tracy: Did you

John: Just learn.

Tracy: Right and learn to ask myself what did I just learn.

John: That's good.

Tracy: Okay so what did I just learn so about facts. And that generally we think of facts as something unchanging and true. But in this context it's saying that facts are based on what was observable an observable agreement by competent observers with an agreement by competent observers and that actually these facts change over time as we learn new information. And so an example that was given was that it used to be believed that the universe was unchanging

John: Fixed

Tracy: Oh

John: You fixed

Tracy: It

John: Fixed and unchanging. Yeah. Thanks for the help.

Tracy: I was just realizing that I didn't remember that word so it was unchanging and fixed and now we realize that it is changing and expanding.

John: All right. Add that feel.

Tracy: What is interesting because I noticed where I didn't. The things that I didn't remember or you know that I thought I knew like I'm like What is a fact. It's competent it's an agreement by competent observers. So I had to think about that a little bit and then. And then I didn't remember the two points of the universe but one is that we know that that's changed. That the view of the universe is changing.

John: So as you're going through that process it may not be comfortable but you can feel learning taking place as you try to formulate questions. What was that. Was they just learned in your so tempted to go back and write. Look at the book. Yeah maybe do that but give it a try to recall that what you just learned aloud delayed retrieval to to do what it does.

Tracy: So actually as you practice this more it does become more comfortable in getting to ask the questions which I know and what do I not know. So so we can grow in that way. Personally.

John: Presently. Excellent textbooks are dense but you need to be able to spend time with it.

Tracy: No wonder they put you to sleep at night.

John: Hey that's not bad because in sleeping there is a lot of processing going on

Tracy: Your

John: Here sleeping. That's another section but the the the book is not something to pick up the night before the exam. It's something to put into your daily routine.

Tracy: It looks like there's a lot of interesting things on in here that could be helpful statistic at least know that they're there. Well before the exam comes

John: You mean

Tracy: In

John: The pedagogy

Tracy: Guise

John: Of the book.

Tracy: Yes. What is pedagogy mean. I love that word and a lot of people don't know what it means.

John: It's a study of how people learn and it's how curriculum is presented. Do you say this first. You say that first. Does it matter when you're asking those kind of questions of how to help people learn. That's the field of pedagogy. So for example in the margins

you'll often see features such as reading check question when did modern science begin. Here we are in Chapter on page three so you need to scan through the paragraph to figure out. When did modern science begin. Oh look it says modern science began when people first became skeptical of their observations and explanations.

Tracy: Ok.

John: And

Tracy: A.

John: You get the idea that if you're actually doing this with others in a study group and you can start talking about the ideas that are there that would be quite useful. So here we are. Chapter 1 is about science. Many textbooks you'll find start out with just the broad general overview of where the book is going. It's a science book. They'll be the first chapter talking about science in general. I've seen some textbooks they actually call it Chapter Zero. You're definitely going to skip over chapters here that you'll find. Exams don't typically go too much into the initial chapter which I think is a bit of a mistake but that's the reality of it.

Tracy: Looks like it's the lay of the land

John: Yeah the first chapter typically provides the lay of the land. You might find parts of it redundant with what you already understand. But as Richard Feynman once famously said about learning. Redundancy is a good thing. So if you have the book with you open it up let's walk through the pages together. If you're out and about listening to this podcast then get ready for a casual review. This first chapter is not particularly heavy so I'm not sure how important our commentary will be here. But I know in future chapters there's much more we'll be biting into that's for sure. But for now let's let's just touch lightly on the main ideas of this lay of the land beginning chapter So here we go with Chapter 1 Section 1 science's way of understanding the natural world within that section. We go into the wheel of scientific inquiry that graphic I got from a wonderful article by William Harwood from Indiana University. That is a nice summary of the scientific way of thinking if you will. We call it the wheel of science to fake inquiry. It

typically starts with asking a broad question. So if you're looking at this graphic it shows a wheel on the rim of the wheel are different points. Learn what is known make observations ask specific questions document expectations perform experiments confirm results and all that and there is no one sequence that any scientists will follow. There are multitude of paths to follow which makes it an interesting thing to do but typically it starts with asking a broad question you follow through. Next step to whatever you feel what's appropriate will maybe I should go to the library or the Internet and learn what's already been known and then I can contact those people and communicate with them and then I can ask specific questions and then I can do an experiment. Then I can make observations that brings me back to wanting to learn more about what is known. There's no one path that's the wheel of scientific inquiry would you think.

Tracy: So it sounds like it's really about asking questions learning what's already known. Making observations. That's how we learn about science.

John: The idea is to be as objective as possible put on your Mr. Spock helmet and do your best to interpret those results from as unbiased a view as you possibly can. That's the hard part because

Tracy: It is

John: We

Tracy: The hard part.

John: We all have these frames which we should talk about in the next next episode. From that frame it colors our perspective and you don't even know it but part of this method if you will is that needs to be confirmed by others. It needs to be reproducible that sets it apart from many other areas of human endeavors like maybe politics sexual in point two goes into the discovery the buckyballs. It's really an example of the Willis scientific inquiry in action.

Tracy: Quite interesting.

John: Indeed. Some important history here. In many ways the discovery of the Bucky Ball was the genesis of nanotechnology. Then it's sexual in point three. Technology is an applied science students often confuse people often confused science from technology they are not the same thing. What do you mean. Well so the technology is there for practical purposes. The science doesn't need the practical purposes it's just how learning how things work.

Tracy: So it's

John: Inquiry inquiry will get you there. Experimentation will get you there working with others will get you there

Tracy: Making

John: Discoveries discoveries. There you go. How the universe is structured how it works. There need be no practical application of it relative to science and technology. You see the two actually worked well together. If you know how things work then you could build things with it for practical purposes. Think the telescope for example. Suddenly you have this telescope which is a piece of technology that expands your ability to to do science so technology and science. They're not the same thing that they feed off of each other.

Tracy: No game.

John: Risk assessment

Tracy: I think

John: Risk assessment is interesting.

Tracy: I've

John: Been thinking about this

Tracy: Lately especially in

John: This time

Tracy: Where

John: People are battling over so many issues so your instructor might go into this notion of the risk benefit ratio where risk is in the numerator and benefit is in the denominator. The question might be should we apply this technology then you'll want to do a risk benefit analysis rather than just a gut feeling. Just go ahead and analyze what all the risks are. Analyze to spell out what all the benefits are and look at the ratio of the two. And once you've done that looking at all the risks looking at all the benefits and details then you're in a position to make an educated decision of whether you should move forward with that technology. Case in point GM owes.

Tracy: Ok. But like for GMO is there should be zero risk. Okay. I was pushing you a little bit because I know there can be there can never be zero risk.

John: Okay.

Tracy: This.

John: What's the saying. A society that aims for zero risks will have zero benefits. Mia thinks one point for looking at facts. Tracy read earlier and the scientific hypothesis in scientific law. Scientific theory. Maybe you should say a thing or two about scientific theory.

Tracy: Okay.

John: What makes a theory scientific.

Tracy: It's based on observation.

John: Look

Tracy: This

John: It says

Tracy: Right

John: Here

Tracy: Was

John: Is a well

Tracy: Wealth

John: Tested

Tracy: Test.

John: Explanation that unifies a broad range of observations within the natural world. The thing with a scientific theory is that the theory itself can change it. It's not carved in stone it needs to adapt to what the observations are.

Tracy: And it has to be tested.

John: Has to be tested well tested in can confirmable by not just one person but by multiple people.

Tracy: So you'll

John: See that.

Tracy: Happen where one group of researchers will look at something and then another group of researchers and another part of the world will use that experiment to see if they get the same results.

John: Yeah to to confirm it and the ideas you're trying to prove yourself wrong. What you're trying to prove yourself wrong. If you if you can prove yourself wrong then that's a big aha moment because that's where the quote unquote scientist will get how this is fantastic. I proved this theory wrong. That's a major achievement.

Tracy: Okay. So again you just brought up the back story of so we can learn by our mistakes and we can learn when we prove ourselves wrong. These things actually help us move forward and grow. I don't know why they get such a bad rap then mistakes and being wrong

John: And

Tracy: Not

John: I'm not comfortable. Right. So one point five goes into chemistry being integral to our lives. We talked about that that earlier. It spells out basic research from applied research basic research. You want a stronger understanding of how things work. Applied research that's more in the realm of technology and a lot of chemistry actually is applied research. Lastly one point six. Almost there scientists measure physical quantities. Now here's the main thing. A physical quantity needs two things a number and a unit. Please include the unit like you can't just say you're three. Okay

Tracy: What's

John: Say

Tracy: In it.

John: Describes what the quantity is. If I say I'm three are you. Three

Tracy: Feet

John: Beats

Tracy: Are you.

John: Three years. Are you three so

Tracy: Do

John: That years or feet is what we call the unit it describes what the quantity is you need to have both of them for the complete description. When you put a number down Don't forget to put the unit down to the last page of this chapter goes into calculation corner on unit conversion. You know that 12 inches is one foot so there's a relationship between the inches and in the feet. If someone gives you 3 feet and you want to know how many inches that is there's a way to do that process called unit conversion. Also sometimes referred to as dimensional analysis it allows you to convert from one unit to the other so three feet would correspond to go through the process. You end up with 36 inches. Okay very good yeah. So we've got a screen cast on the mechanics of how to do the unit conversion. Your instructor may spend a fair amount of time showing you unit conversion y. You'll find later on in the course the unit conversion turns out to be a very key tool to be able to understand the world of atoms and molecules. They're so incredibly small. Those little buggers that we can't talk about them in terms of grams or or pounds we need to talk about them in terms of these other units that are more appropriate to the universe of the super super small. So that's why unit conversion is particularly important for chemistry course

Tracy: Okay. And then we get to the amazing the best part of it all reading check questions and think and compare. Think and explain

John: The thinking explain. Questions are perhaps the most important. These are the ones that you'll most likely find on an exam. Don't expect that the answers going to be right there at the tip of your tongue. If it is that's great but don't expect it to be. It's not supposed to be it's going to require some thinking and then some explaining. You know Tracy it's interesting. Halfway through the semester I'll have students come up to me. It's only then that they discover the solutions are in the back of the book.

Tracy: Okay. I didn't know that

John: The solutions are

Tracy: In

John: The back of the

Tracy: Book

John: Oh really. Yeah. Now they're now they're glad they're listening to this podcast. The solutions to the odd numbered questions are in the back of the book which makes sense because Instructors want the student to do these four for homework often. Now word of warning. All right I told you. The solutions to the odd numbered questions are in the back of the book. Don't just go to the back of the book and look at the answer without trying to come up with it yourself. I tell you. You'll read the answer to the solution and it'll make sense. It will make sense to you and you'll get that warm fuzzy of oh I got it. I'm good. I'm gonna ace the exam. No you're not the one who wrote the solution when you can get to the point where you can come up with the solution. The answer on your own. That's when you're doing well. That's got to be your goal.

Tracy: So maybe you have a friend that will be willing to look at your work and correct it in the back of the book and then give you back your work saying hey try these couple questions again. You didn't get them quite yet.

John: Or an even better friend who's willing to listen to you as you stumble trying to articulate an answer to one of these questions. Now over a cup of coffee. I think we did it, Trace, our first episode.

Tracy: That wraps up our first episode of Chem 101: The Big Picture Podcast. Thank you so much for joining us.

John: Our theme music by Zac Geoffrey. All those fun musical flourishes throughout the show. Supplied by Garth Orr and John Andrew. Production assistance from Greg Simmons engineering from CPro music for show notes and more please visit conceptualscience.com. A note of appreciation to all the instructors using Conceptual Academy. Thank you for your support and to you the hardworking student. Our thanks to you as well to your learning efforts. We see the path to making this world

a better place. And through it all. Remember that one's education is the flavor that remains after all the facts and figures have been forgotten. There is a bigger picture. That's good chemistry. Good chemistry

John and Tracy: Good chemistry to you.