Big Picture Podcast - Episode02

The Anthropology of Learning

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

John: We're here is 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 improved social skills to

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 your journey into the big picture.

Tracy: At your service

John: This is the Chem 101 Big Picture podcast. So glad to have you on board. Welcome to episode two of the big picture podcast.

Tracy: We're gonna jump right into the back story segment.

John: Backstory. And today's back story topic?

Tracy: The anthropology of learning

John: I suppose though we should define anthropology first. I see you have the definition right there. Go ahead.

Tracy: Sure do. Okay anthropology the study of human societies and their cultures along with their development.

John: So when we say the anthropology of learning we mean how we learn within a social context right?

Tracy: Yes. You mean how we're not computers. When we learn we're not just downloading information

John: You know that's big picture stuff. So to start things off can you go ahead and read that story on the the White Rock.

Tracy: Okay here we go.

John: Okay.

Tracy: In a land not so far away and not so long ago. . .

John: Ahhh

Tracy: there lived these people. Unbeknownst to these people they each wore an invisible filter over the cornea of their eyes. Now there were those who wore a green colored filter. And those who wore a yellow colored filter. One day, two of these people were admiring this brilliant white rock. "What a beautiful green rock." One commented to the other. The other said

John: "What are you talking about? This beautiful rock is a beautiful yellow rock."

Tracy: Puzzled. The first replied, "You're so crazy. This rock is clearly green as the grass enraged." The second replied.

John: "Crazy look who's crazy. This rock is clearly yellow as the sun."

Tracy: So sadly in their disagreement the two stomped off in different directions never to speak to each other again. The end

John: That's a tragedy.

Tracy: Yeah. Why couldn't that have a happy ending?

John: Well, what's the point.

Tracy: So the point is that we each have some sort of filter that filters the way we see things

John: Yeah I've been reading these cognitive science textbooks and what's caught my attention is that there's this model of how we perceive reality. It's the model of a frame and they say a frame is like an invisible filter built inside each of our heads.

Tracy: Right. When you use the word frame are you saying like a point of view?

John: Yes but much more than a frame of view. The thing about the frame is that they've mapped it down to actual physical structures in the brain like down to the neurons

Tracy: So our brain actually develops based on how we see things.

John: And that frame. Those neurons getting all piled together is something that of course develops over a lifetime really. Based upon all your experiences the people you're with all those influences you know that soccer coach that really helped you out. Well they helped to build part of that frame within you and it's something you carry with you throughout your life.

Tracy: So on a really like neurological level our brains are different.

John: They're the same and they're different. What they're trying to point out here is that this is one of the ways in which they can be different. And one of the ways in which they can be the same and they use this idea of of a frame to explain all that how it is we sometimes think like how it is sometimes we think differently. The frame actually shapes our views.

Tracy: So then we're gonna probably be more comfortable with people that have the same frame as we do. So it's

John: Yeah.

Tracy: The Greens the Greens the people with the green frame probably hung out

John: People

Tracy: With people

John: The

Tracy: With

John: Green

Tracy: The green

John: Filters.

Tracy: Frames

John: Yeah yeah

Tracy: The green filters.

John: And the yellow. The people with the yellow filters like to hang out with people the yellow filters because they they can agree on things more readily. And frankly that that's more comfortable. So that's that's the idea. This notion of of frames mental structure

Tracy: Okay.

John: Built with within each of us.

Tracy: So this is somehow related to chemistry right.

John: Of course since this is the big picture podcast right? So with chemistry you see we go into these issues that are sometimes controversial or divisive GM energy sources, agriculture, global warming, things like that really is at the heart of a lot of these and if we're going to address these issues my thinking here in terms of the big picture it's going to be important that we at least identify any filters that we may be using as we explore this material.

Tracy: So we probably have pretty strong opinions about how things work in the world or how we see things in the world.

John: And opinion isn't just an opinion. The cognitive science is saying the opinion itself is a consequence. the person's frame

Tracy: Are we going into politics or

John: Oh I'm

Tracy: Memes

John: Sorry

Tracy: Or

John: The politics. Yeah because you know you start talking about controversial or divisive stuff. I guess the first thing you're gonna think about is like, well, politics anthropology is the study of human society and that's going to necessarily include all the political stuff but I think it better we steer away from describing you know the progressive and conservative frames and we'll have to wait till someone produces it through one or one the big picture podcast for that. But but I do think it's fair for us to at least introduce this idea of frames and to show how it has such a significant effect on an on Well the very notion of of common sense.

Tracy: Common sense is common sense isn't it?

John: That's the main deal. They say the answer is No. What constitutes common sense totally depends upon the frame that you're using one frame that might be total common sense but yet from another frame the very same thing could be utter nonsense Think of this. They used to go fishing by dynamiting coral. So you see what you do is you take the dynamite drop it into the coral. It blows up and all the stunned fish float to the surface and you scoop them up. Pretty good huh?

Tracy: That's horrible.

John: Think of it you're the fisherman and all you do is blow up a stick of dynamite and you're done. You just scoop

Tracy: Have a group

John: Up

Tracy: Of.

John: All the fish that that's a good thing.

Tracy: We know how long it takes for coral to grow.

John: Yeah. That's another frame from one frame you would see it is totally immoral to be blowing up the coral just to go fishing

Tracy: Totally.

John: Right.

Tracy: Absolutely.

John: But

Tracy: Yeah.

John: From another frame you could see blowing up the coral as being a great thing gets helping you to feed your family. How moral is that? If some American's going to come and tell you to stop doing that to tell you that you're not allowed to feed your family. I mean how arrogant and moral is that? The point being the frame you come from can actually define your common sense. It can define your sense of morality as well. That to me is really wild. Really freaky.

Tracy: And I'm still trying to grasp this whole idea of framing.

John: As But as we go into various topics of chemistry and my thinking here is it's important that we identify that we may have this thing called a frame built in their heads. So one frame may lead us to conclude that a rock say yellow while another frame would lead us to conclude that the very same rock is actually green

Tracy: So you're saying a conclusion is very much the result of a. Of a frame?

John: More so than in fact the physical facts can take physical facts and throw them at the frame. But if they don't fit the frame then all the facts will just simply bounce off like like Teflon. They won't stick.

Tracy: Ok then if you're trying to convince the guy that the rock is really green but he sees it as yellow you could show him all the evidence in the world and it's not going to convince him otherwise.

John: So clearly you see here the first step has to be working to convince him that he's seeing the world through this colored filter overs cornea. And that's not going to be easy. And only then and only then I'm thinking you would have a chance of getting him to recognize that to the objective universe that rock before him is actually colored white.

Tracy: Okay. So just by understanding that these frames are even there helps to push us in the direction of objectivity.

John: It's a step.

Tracy: All right. Can we relate this back to the fishermen. Fishing with dynamite.

John: I mean how do we get him to switch from a frame that is provincial to one that is more global? You know that's when we move from the important work of anthropologist in neuroscientists to the important work of social workers, educators, and even politicians. of them working on behalf of the larger community. It's a task of changing a culture. And gosh that's akin to I'd say moving a mountain you know you need?

Tracy: You would need a slow but sustained effort.

John: One fisherman at a time.

Tracy: Ok so a frame. Is a mental structure. That shapes the way we view the world.

John: And not the easiest thing to change in any one

Tracy: It would mean letting go of old common sense for just another new one.

John: For a new one. And it tells us that get this common sense is truly relative. And if you're trying to do science you'd better be careful in using common sense as your guide.

Tracy: Physical evidence.

John: Yes physical evidence that that's better the physical evidence that can be confirmed by many not just yourself is an important way of skirting around this. This framing issue first try to recognize any internal frames leading to bias. Second as much as your framing allows if not more rely on verifiable evidence. I got to say that's a high bar for any of us. That's what I thought we should be saying about frames. Our worlds are colored. That can be a beautiful thing but also a serious obstacle.

Tracy: Next. You said you wanted to talk about hypo

John: Yes. That's when there's no word to describe an idea. It kind of hinders us not having that word

Tracy: What do you mean when you have you have no word to describe an idea. Well.

John: Words have value.

Tracy: Yes words have value.

John: And it's so nice when you can sum up a big idea or a pervasive idea with a single word or phrase

Tracy: And so hyp is?

John: When when you lack a single word or phrase to describe that idea you know there are many instances when there is this big idea for which a word or phrase simply doesn't exist especially like across cultures we should phone a friend. All

Tracy: Right.

John: Someone who knows cross-cultural stuff

Tracy: You mean somebody who maybe has lived in two cultures or more. Okay how about Stuart. Stuart a good friend.

John: That would be funny. Let's call.

Stuart: Hi.

Tracy: Hi Stuart this is Tracy and John calling.

Stuart: Hi Tracy and John.

Tracy: How are you doing?

Stuart: I'm doing well. Good to hear from you.

Tracy: Cool. Well we're recording right now. If I could just give you a brief introduction. This is Stuart Paton founder and Sensei, which means main teacher, of Burlington Taiko. Stuart grew up in Japan and the U.S. He has keen insight into both of these cultures. So we're calling you Stuart to ask about words that may not be in our American culture that might be in Japanese culture.

Stuart: Well I, I will speak from my experience. I'm bilingual. I speak Japanese and English. I learn both languages in my diapers.

John: Ha

Stuart: I think that is the best way.

Stuart: I find it easier to come up with examples when I'm speaking with a bilingual person. We would speak something that we call Chung Pon. Speaking a mix of English and Japanese. We would jump from one language to the other depending on which words or phrases most fit. The feeling for you what we wanted to say now it is very useful. I think when when we were speaking you know sometimes we just couldn't find the word in English and so we would jump to Japanese or vice versa. But there were a lot of times when just the aura and aroma of the words really matched what we wanted to say better in Japanese or better in English.

John: How about amea?

Tracy: May.

John: Or may a May. That's

Stuart: That's a very good American pronunciation.

Stuart: Let's see. Oh my

John: My my my. OK. What's it mean.

Stuart: Ha. Let's see. I think of it as becoming softer and younger and kind of curling into a cradling space. Often it's in interaction with the person you know a daughter might admired you or admire you know into into father or mother. I think of it as a little bit of. What would it be. Kind of like a Hearts. Time travel kind of back into an earlier time when the relationship was. Was it the nurturing was even more potent and more concentrated and

John: So

Stuart: That's

John: It's

Stuart: The

John: A type of relationship between people

Stuart: Yeah I think of it as a yes an interaction a verbal or a choreography gesture that one person does towards someone else who would have been in a nurturing position or is in a leadership or position of empowerment.

John: Well.

Tracy: So can I ask you a question.

Stuart: Is it

Tracy: If there's a word for that in Japanese. And there's not a word for that in English. Do you feel like that people without that word also have that same experience without a name for it.

Stuart: Yes I think so. And as well as Yes I think so but you

John: You're

Stuart: See

John: Saying it parts of

Stuart: The

John: It are uniquely Japanese.

Stuart: I think parts of it are uniquely Japanese. And I feel that the the first language that the person speaks influences how they experience the world and interactions. And and even feelings. Someone with two first languages. They have two personalities. They are two selves. And when they when they speak and you know when I speak in English I have one personality.

John: Mm hmm.

Stuart: And I think our software our wiring is different in each first language. And

Tracy: It's interesting.

Stuart: I think I think well yeah I think what we feel can can also be different because of that

John: Words are they have value. They're crazy. They're like

Tracy: Yeah.

John: Wow.

Tracy: That's what this whole conversation is about is is do we need a word to describe something. And if we don't have a word then is it is that experience either not available to us or do we just not have any way to work with it. So.

Stuart: I think it is. I think it is available to us how to speak about it with another person I think might be the deeper challenge. Or it may be harder to hit a bull's eye when speaking about it with another person. I find when I'm doing interpretation from one language language to another especially going from Japanese to English I find that I am painting a picture scenario with a lot of words that surround the idea that I'm trying to communicate so that what is it that the branches and tendrils that connect to other aspects of the experience. And I'm trying to recreate that in English.

John: Stuart thank you so much for your very keen insight into this.

Stuart: My pleasure and I feel like the more you asked me about this topic the bigger it grew.

John: To see anything else.

Tracy: Thank you so much sir. That is it's really interesting thinking about language and how much it shapes how we think and what we see.

John: All right Stuart thank you for joining us here at the big picture podcast.

Stuart: My pleasure thank you Tracy and John.

John: That was great.

John: And so the argument here is that when you have a word for this idea it gives you a stronger handle on it. It gives you an ability to appreciate more. I think all of those ideas. It's like it's a label. It allows you to get a handle on it as

Tracy: So it's sort of

John: Like a

Tracy: Shared knowledge.

John: Yeah. And it makes it easier to communicate. That's the idea of hypo cognition when you have an idea and there's no word for it. You don't mind I'm going to mention this from Robert Leavy. Kazin was an anthropologist who studied Haitian culture in the 1960s and he was looking into play how was that the suicide rates in Tahiti were high. He he's the person who actually coined the term hypo cognition. He found that within their language they had no term for grief. So when the tuition. His theory goes is finding the sense of grief. They wouldn't be able to label it as such. They would just feel like they were sick they were ill they were they were in pain. And so there was an understanding between people of what was going on and not knowing what was happening to you because just not having a word for it he proposed was what actually led to the high suicide rates.

Tracy: This is work from the early 1960s.

John: That's yeah that's that's what I'm. That's my understanding.

Tracy: So that's not long after World War 2. So I'm wondering World War 2 wasn't that gentle to the Pacific Islands.

John: Whoa yeah. A clash of cultures caught up in the war between the U.S. and Japan. Things would surely have changed upon that within Tahiti.

Tracy: And I wouldn't be surprised if the notion of grief was very different in Tahiti before World War 2.

John: That's a good point.

Tracy: Okay wait. Where are we going with this. Why all this focus on hyper cognition.

John: Cultures are running into each other more and more. Right

Tracy: Well sure.

John: Yeah. Why.

Tracy: Modernization. The world is getting smaller.

John: A new situation.

Tracy: Would you mean.

John: Perhaps fertile ground for new ideas.

Tracy: Fertile ground for new ideas. Okay.

John: So across the board we're going to need new language just to keep up. How about collective causation.

Tracy: Which is.

John: Well there's some hypo cognition going on now With collective causation. I'd say it's yet to be fully identified and embraced

Tracy: What's collective causation.

John: Collective causation. That's when a bunch of little things add up to a big thing. Those a.

Tracy: Okay. Well cause.

John: You knock over a glass of milk. That's the cause of the spilt milk.

Tracy: Yeah.

John: It's a we would call that direct causation. You stub your toe.

Tracy: And you. It hurts.

John: It hurts. Yeah. So that's a direct causation right.

Tracy: Yeah.

John: So collective causation is when you have a bunch of little direct causations is all adding up. For example the cigarette. One cigarette is probably not going to give you lung cancer. Probably not. Probably not. But a million cigarettes probably will.

Tracy: Probably would.

John: So one cigarette I would call a micro causation and a whole bunch of micro causation is add up together to give you a collective causation.

Tracy: Okay

John: Yeah

Tracy: I get

John: Yeah

Tracy: It.

John: Yeah. So one stake is not going to give you our arteriosclerosis. You say one kid doesn't get vaccinated you know. Is that going to cause a problem. How about the laundry one load of laundry. We talked about that from the last episode or one trip to the grocery store or you know burning up one tank of gasoline that is second cause an increase in carbon dioxide levels. Those are all examples of micro-causation. But you got to understand, one raindrop is a micro-causation and you have a lot of raindrops. That is a collective causation of a flood. A bunch of little things adding up to a big thing.

Tracy: Okay. Yeah.

John: All right. So collective causation. Oh and you know the thing about that micro causation is they're easy to discount. I mean that might be why it's so hard to give up smoking or one of the reasons is that while this one cigarettes not gonna be a problem or this one steak is not going to give me arteriosclerosis or this one drive to the grocery store my fossil fuel burning car that's not going to have a major impact. And you know what. It's not it's not that one trip to the grocery store is not going to have a major impact that one cigarette is not going to have a major impact. That's just

Tracy: Incurred.

John: What it is

Tracy: But anyway.

John: Not. But not likely. And so that's why a micro causation is so easy to discount and just just plain ignore

Tracy: Just one little thing.

John: Just one Swan little thing. Yeah. Yeah. So why in when would a micro causation be a problem.

Tracy: It will be a problem when you have a lot of them when

John: In

Tracy: You have many.

John: And only when you have many

Tracy: Right.

John: C guess how many of us there are on this planet.

Tracy: There are over 7 billion people.

John: That seven thousand million

Tracy: It's crazy.

John: That's that's a lot of people. What we're seeing are a bunch of collective causation is occurring all around us

Tracy: Some examples.

John: Ok. We talked about it. An example in the last episode with the laundry. You've got micro fibers that going down the flow through the washing machine. I know nothing about the dryer. I'm talking about the washing machine. Yeah. There's lint that goes into the washing machine and then out the drain and into the ocean. And if you're doing just one load of laundry that's not going to cause a problem with the ocean. But if you have 7 billion people doing that. That's a collective causation.

Tracy: Right. Even if you have 3 billion people doing that.

John: 3 billion. Yeah. No we need it the greater the numbers the more significant it is.

Tracy: Okay so that makes sense so it has to do with their world population with so many people adding to something adding to carbon dioxide emissions or adding to.

John: How a vote. You know you might think oh my one vote won't count.

Tracy: All right everybody adding to a vote

John: That

Tracy: Their votes at

John: Your

Tracy: Our

John: Vote counts it really does. And when you see the results of that election you know you should be thinking collective causation and when you see a news report talking about a dead whale washed up on the shore found with 65 pounds of plastic in its belly again the first thing you should think is all the collective causation. So we need a culture that appreciates collective causation. How real it is. But the thing is you're not going to be able to build within yourself. Let's call it a collective causation frame until you have a really palpable sense gut level sense of just how many of us there are

Tracy: Yeah there's a lot.

John: If you're ignoring that math then sure go ahead and don't worry about any micro causation. It's not going to be a problem. So see we're talking about here is a shift in culture to have people who recognize micro causation as a thing going back to the dynamite scenario with fishing or just just wants to kid dynamite. It's not going to not going gonna be bad.

Tracy: I just was thinking well if we all have if we all can have a negative impact in the world then we need to all be responsible for how we act.

John: That

Tracy: Each one of us

John: That is that that's a frame that you're building that we're that I believe needs to be built and I don't see it as a progressive frame or a conservative frame. I actually see it as a mathematical frame so the

Tracy: A mathematical frame?

John: The population and the human population is over 7 billion. True or false. True true or false. Many people produce more carbon dioxide than what comes out of their mouth. All right.

Tracy: To.

John: Increases in the atmospheric level of carbon dioxide. They're coming from us. That's the math. Now if you ignore that there's 7 billion of us. You're ignoring the math. So what if there are only 10 people on this planet. Would it be okay to throw that plastic bottle over your shoulder.

Tracy: Where would they get a plastic bottle if there were only 10 people on the planet?

John: Okay.

Tracy: Is.

John: Suddenly they found this plastic bottle suddenly appear and

Tracy: Fell

John: Is

Tracy: Through

John: Filled

Tracy: The sky

John: With water in it and you

Tracy: Drink.

John: That wonderful water. And what were you gonna do with that plastic bottle you just threw it to the side of the road.

Tracy: It would probably be sitting there a long long time.

John: Yeah but would it be okay

Tracy: If that's what you want your world to look like if you're one of those ten people.

John: But would it cause a big pollution problem.

Tracy: No it wouldn't cause a big pollution problem if be one plastic bottle. Ten people walking over it. So

John: It seems like a lot of people live their lives thinking there are like only 10 people on the planet at least when you're throwing the water bottle out the car window

Tracy: People don't do that.

John: They do and they did for a long time but

Tracy: Notice

John: That's slowly changing now isn't it. Because there's this awareness let's call it a collective awareness of the impact of one small thing when you have large numbers and when you're driving down the highway and you see all the trash on the side of the road perhaps only then you begin to realize Oh I don't want to be one contributing to that. And as you're doing this you're building a frame within yourself back to the fishermen using dynamite. It's not that they're wrong it's that they're coming from a different frame.

Tracy: Back to that example I mean eventually they would see that they couldn't always continue getting the fish and that eventually generations after them won't be able to get fish.

John: So you're saying one frame might be anchored in short term thinking

Tracy: Yes

John: While another frame might be anchored more in long term thinking

Tracy: Yes. And also I mean are these frames flexible. Are they like set. Or do we. Do they change as we learn.

John: Yes and no. They can get really deep seated. But again as with any thing human there's always room for growth as well. What I've been reading is that it can be really entrenched because your sense of common sense is just it doesn't you don't you're not going to question here's your common sense. And with those invisible filters you're You don't even know that that's at play.

Tracy: Yeah. But I know I've learned things in the past 10 years 15 years 20 years five years. I'm not the same person.

John: In you know I think that comes greatly from our interactions with others. You know when you have people with different frames. Getting together. Whether a conservative frame or a progressive frame a strict or nurturing parent type of frame or risk averse risk inclined provincial global all these different frames of different colors you know we've got so much to learn from each other so much to try to understand.

Tracy: Too. Yes.

John: The collective wisdom we call it. The thing about collective causation I like it because it's fairly simple remember step one step to learning.

Tracy: Mm hmm.

John: To me it's fairly simple. Step one input step to output but it explains so much. And likewise with this idea of collective causation. Little things add up to big things. It explains so much in this. This modern day world where we've got so many of us here on this planet. So I challenge anybody to go and look up collective causation and Google.

Tracy: And where will we find.

John: Sadly nothing.

Tracy: It who remain.

John: It doesn't exist.

Tracy: How does it not exist.

John: We're sitting here talking.

Tracy: About it.

John: I made it up so I'm doing the study on a hypocognition and then thinking about all these issues with chemistry and I realized that this is something that's sorely missing. The idea that little things add up to big things. I mean we all understand that little things add up to big things but we don't have a single term to describe it all in that I think holds us back. It's a hindrance. There are so many examples in this modern day where collective causation is a problem. And the reason it's a problem now is because of so many of us and there are only so many of us. Only recently we've got over 7 billion now. A thousand years ago maybe 200 million

Tracy: When we were kids the population was half it is it was half of what it is now. When we were kids when

John: Was

Tracy: We were first born in our

John: Life.

Tracy: Lifetime.

John: Yeah. So this

Tracy: Idea

John: Of

Tracy: That

John: Where

Tracy: We're

John: There's

Tracy: There

John: So many

Tracy: And

John: Of

Tracy: We're

John: Us

Tracy: Not that old.

John: That that there's so many of us that that's new. So I don't think it should be a surprise that we just don't have a term like collective causation because it hasn't been a problem before it hasn't been a problem until now.

Tracy: All right. See you made up this word so we could talk about this.

John: I think it's a term terminology we should be using actually throughout the course micro causation is a bunch of them lead to a collective causation.

Tracy: Cool. Yeah. So we covered.

John: In this episode to the backstory

Tracy: So we looked at the invisible filters

John: The

Tracy: Frames frames.

John: How they color our world view without our even knowing it.

Tracy: But it's not even just a view it's it's embedded in our brain.

John: Yes

Tracy: That's that's

John: Wild. Reminds me of a rap song.

Tracy: And then we talked about how do we

John: Their

Tracy: Take

John: Act.

Tracy: The.

John: They're activated by words of frame. It's activated by words so words are really important. Politicians they choose their words really carefully.

Tracy: Okay.

John: We need tax relief. You

Tracy: I'm

John: Know

Tracy: Sure

John: Advertisers

Tracy: Also choose

John: Who.

Tracy: Their words carefully.

John: Who brings good things to life.

Tracy: I

John: No

Tracy: Know

John: I want

Tracy: One.

John: To mention your tax dollars at work. I think we need more signs on the road showing our tax dollars at work. So that's the idea of a frame right. And then then we talked about hypo cognition which is the idea of not having a word for an idea. We brought that up so we could skillfully introduce the idea of collective causation

Tracy: A bunch of micro causation is leading to a collective causation.

John: Yeah exactly. So micro causation is our only a problem.

Tracy: Because there's so many of us.

John: So it's a modern day problem. And so we need a modern day phrase to.

Tracy: A modern day way to look at this

John: How about collective causation.

Tracy: Sounds good. Let's put it in Wikipedia.

John: Did I tell you I tried that.

Tracy: Did you.

John: I did you know they declined it

Tracy: They declined it.

John: Because they said it wasn't a word has a clause about a word I'm trying to do is that we don't accept

Tracy: Up.

John: Made up words. But but but but where might it begin. So

Tracy: Will it be a word in three weeks.

John: Well we'll see. Let's get this podcast wrapped up. This fun

Tracy: To the review.

John: Do the review. Chapter 2.

Tracy: Here we roll. OK. Let's do the review.

John: Welcome to do the review for Chapter 2 This is the segment where we just simply walk through the textbook chapter providing helpful commentary as we move along. This is the kind of stuff that awesome to listen to say the name for the exam while you're driving around town or doing the dishes or your laundry right. Sounds

Tracy: Good. Yeah.

John: For

Tracy: We're

John: Cooking.

Tracy: Good healthy food.

John: All right. We are starting off here with chapter two particles of matter hey Tracy there's a picture.

Tracy: Yep.

John: Yeah. What are you doing.

Tracy: Do we. And do you mean doing I'm smelling a blues.

John: Spell it. Why are you smelling a balloon

Tracy: That's the cinnamon bloom.

John: It's from an activity I did at the beginning of this semester where I pass out these balloons one balloon is filled with a little bit of water another balloon is filled with a little bit of cinnamon oil. I pass them to teams of students and I ask one has water in it one has cinnamon which has which and they give me this blank stare and I just hand them the balloon and there to investigate.

Tracy: Is the blank stare because it sort of seems like utterly obvious and insulting.

John: I think they see it as a weird request and they're like what. But what follows is just remarkable. The students they hold up the balloon to try to look through it they will shake the balloon and they will try to feel the differences in their weight. And it takes about three to four minutes maybe sometimes longer before one student will randomly put their nose to the balloon and get that aha moment. Oh well this is the one with the cinnamon

Tracy: Wow. Do they really feel similar in the beginning.

John: The the weights are the same. I just used different colored balloons and the thing is they come up and say that this balloon has the cinnamon in it. I said No no no that's not possible because the balloon is sealed. The air's not getting out so there's no way you're smelling the balloon because the air is stuck inside C because it's obviously still inflated. And then they need to explain that to their neighbor. What's going on

Tracy: Sounds

John: And

Tracy: Fun.

John: How can you smell the cinnamon coming from that balloon.

Tracy: You don't want to leave this to the listener to figure out.

John: Good idea. Let's just say that with that balloon you have before you evidence for the existence of the particulate nature of matter. Another meat when we do is a hold up a cylinder fifty point zero the leaders of ethanol and fifty point zero million liters of water and ask the students. When I combine these two how much total solution will I have

Tracy: Of course one hundred. Sorry forgot the unit 100 milliliters of water.

John: Excellent. Forget the unit. So in a math class 50 plus 50 equals 100. In a chemistry class 50 plus 50 unit units a milliliters adds up to

Tracy: You're not going to give this away every.

John: All right. Is it more than a hundred. Is it a hundred or is it less than a hundred. You

Tracy: Might be surprised.

John: Think particles. All right. That's the idea behind Chapter 2 particles of matter in Section 2 point 1 the sub microscopic world is super small addresses the idea of how incredibly small these particles are. There's a fun video at conceptual Academy you'll find on it's a powers of 10 type of video where you go all the way down to down down down to the the world of atoms and molecules to get a sense of just how incredibly tiny these things are. So that Section two point one.

Tracy: And this is where you point out the name of particles as molecules.

John: Oh yeah. And here we see the definition of molecules of molecules a group of atoms linked together so our atoms made of molecules or are molecules made out of atoms.

Tracy: And what's a particle.

John: These are questions you'll be able to answer after studying section two point one section two point two is a section on the basically the history of modern chemistry. I love the history of chemistry. How did they come up with these things in the first place. I mean thousands of years ago you didn't have all the modern instrumentation. There's another interesting question what if you were suddenly transported back to say 10 years ago and you knew all the information from the 21st century. If you were sent back in time with nothing but the clothes. No not even the clothes on your back because that would be polyester. Weird materials you're sent back in time with only the knowledge of the 21st century. How could you survive in that time without being

Tracy: Persecuted.

John: As

Tracy: Are

John: It's

Tracy: Thought

John: Of as crazy as a as a sorcerer or witch. Think of what would happen in that scenario quite interesting

Tracy: In the context of framing they would never believe you.

John: But think

Tracy: You never

John: Of her now.

Tracy: Know.

John: We'll

Tracy: I mean

John: Think of the advantage you would have especially after having made it through the chemistry course. The section two point two goes into the history of chemistry and over the various editions it's just sadly been shrinking in size down to the.

Tracy: Bare Essentials

John: Yes

Tracy: You know the bear

John: Story. There's love was the way the father modern chemistry. There's Dalton who really helped us with the discovery or the realization that there are these things called atoms and there's Mendel you have who organized the periodic table so Love was a

Dalton and many of were definitely key characters and in the history of a modern chemistry there are many others read Section two point two. You'll get that brief overview of how we got to where we got to today. Section two point three masses how much volume is how. How spacious how much space it occupies. Chapter 2 we're laying some terminology down here. Ideas like energy and he's like atoms molecules mass weight. This is a language that we'll be using through the course and it's important to note not just in chemistry nor just in physics but in your life in general. There is a difference between mass and weight. Tracy you're on.

Tracy: Retro.

John: You took the chemistry course.

Tracy: Now. That's why I'm here doing this review with you.

John: Unless you're using the material routinely. It's not going to be on the tip of your tongue but after having learned it already there's a frame inside you. Let's call it a chemistry frame that allows you to have these broad brush stroke understandings Masses how much stuff you have. It is the simplest of all units actually.

Tracy: So it's the amount of matter or protocols that you have.

John: I like I like to think of it in terms of the amount of particles you have. That's good. The more particles you've got the more mass you've got mass is given in units of grams or or the kilogram weight is much more complicated. It's the gravitational attraction between two masses typically one small mass in a very very very large mass known as a planet or bigger.

Tracy: So then that's why the wait would be different on planet Earth than it is on Mars or

John: The moon or something. That's

Tracy: That has

John: Right.

Tracy: Different

John: Gravity

Tracy: Gravitational

John: Invitational Paul.

Tracy: Pull.

John: And if you're floating deep in the middle of space in between galaxies. Your weight

Tracy: If there's no attraction to another body than a body or planet then their way to zero.

John: Suffice to say when you start talking about weight you're talking about gravity and that is so much more complicated than this concept of mass. So guess which one we're going to deal with mostly throughout this course.

Tracy: Seems to me that chemistry is gonna be concerned with how much of a material we have and looking at how that reacts. So I would say mass.

John: It's not just that it's simpler concept it's more more of a germane concept as Tracy just noted. It's that's a measurement of how many particles you have. When we start talking about particles you're talking about the world of chemistry. So yeah mass will be our main focus here. Volume is a measure of how much space that mass occupies that leads up to section two point four where we talk about the density where density is the ratio of the amount of mass you have to the amount of volume you have

Tracy: Would you rather have a bicycle frame me to have led or would you rather have a bicycle frame made of aluminum

John: Okay.

Tracy: Zip

John: So they'll

Tracy: Will

John: Take a.

Tracy: Up the same amount of space. They both have the same structure.

John: If they both have the same structure and occupying the same amount of space one made with lead and the other made with aluminum which one would you want.

Tracy: The letter one.

John: Easier to push right

Tracy: Exactly.

John: Mass. It's also related to this notion called inertia and the more inertia you have the more difficult it is to get it moving so you have that bicycle made of lead has more mass it's more difficult to get moving and if it's a bicycle that's not what you want you want it to be as light as possible is to say you want it to have as a little inertia as possible.

Tracy: So then what you're saying about density is this suggests that they have different densities.

John: If you've got the same volume the more dense material will always have more mass. Okay moving right along the next section. Energy is the mover of matter now. I like to think of it like this. There are two things in the physical universe and they include energy in matter and the two are actually equated to each other within Einstein's famous equation E equals M.C. squared where E stands for energy M stands for matter. The great implication of this equation is that it's telling us energy and matter are really two forms of the same thing like like one mouth that can either smile or frown it's one mouth and matter we see manifests itself in the form of inertia. That's like the frown energy by contrast manifests itself in the form of a wave that's like the smile. If you're seeing waves on the water you're witnessing their energy and of course the higher the waves the more energy you're witnessing

Tracy: Here you define energy as the capacity to do work.

John: Now work as per the laws of physics is a force applied times distance. So if you want to move something it's going to require energy to do that energy we say is the capacity to do work it's the capacity to apply a force over a distance. Note carefully we say the capacity to do work because it doesn't mean the work's going to be done. If you try to apply a force to a table that's bolted to the floor. You could push and push and push but the table won't move anywhere so if you've gone no distance. That is to say no work has been completed But you have in fact expended a lot of energy. You are tired from having applied that force over such a long time. So really careful when we talk about the definition of energy as being the capacity to do work there are two types of energy. They are

Tracy: Potential and kinetic.

John: Energy is the energy of motion. If you see something moving it's the capacity to do work. By virtue of its motion potential energy is the capacity to do work by virtue of its location. Case in point a boulder up on top of the hill. It's not doing anything yet but it has the potential to do something which would be to roll down the hill which means it's converting from potential energy to kinetic energy within a chemistry course were typically working with the concept of chemical potential energy. When you're looking at a firecracker the atoms and molecules in there are arranged precariously. They are ready to explode. They're not exploding yet but they have the potential to do that as soon as you light the match. There's a series of chemical reactions and you have the explosion. What's happening there is that what you call the chemical potential energy is transforming into kinetic energy the kinetic energy of all the fragments flying off in different directions.

Tracy: So kinetic energy is the energy of motion and potential energy is given by virtue of its position. Sounds like it's gonna take a lot of energy to get all this down.

John: You know like on a movie set when the director calls out energy people you know what he's saying is he wants them to pull out their energy so they have the capacity to do all this work which would be to create the movie right. So energy Students Yeah get a good night's sleep. So you have the energy you have the capacity to do your work

Tracy: Give yourself plenty of time to study this material so that you get the language down and you won't get tripped up later when you're actually using these concepts.

John: We can differentiate between the language and the ideas the language describes the ideas get the ideas about

Tracy: Get

John: The language. Well we talked about this that the words are important. Yeah right. So gosh we're building a frame within ourselves aren't we. As we take these ideas and incorporate them into our world view.

Tracy: Into our understanding of the world around us.

John: Moving along next section temperature is a measure of how hot heat it is not temperature and heat are one of those things that are not the same thing but they are closely related. Temperature is a measure of how fast those particles are moving. Heat is a measure of energy. We might call it thermal energy and it's best illustrated I think by the following question. You've got a mug full of water at 100 degrees Celsius which is a boiling temperature of water. You've got a swimming pool at 100 degrees Celsius. Do you recognize they have the same temperature

Tracy: They are both 100 degrees Celsius.

John: So that 100 degrees Celsius is a measure of the temperature. It is a measure of how fast the atoms and molecules are moving. So if they have the same temperature you'll find that the atoms in the mug of hot water are moving on average just as fast as the atoms and molecules are moving in the swimming pool full of hot water

Tracy: So temperature is how fast molecules are moving.

John: Yes. And when you stick the thermometer into the mug or into the swimming pool you're taking random samples of okay. How fast do the atoms and molecules moving here. Over here and you'll see that between the two bodies of water the atoms and molecules are moving at the same rate.

Tracy: All right. Wait a second. That's very cool because your thermometer is only a usually a glass stick. I guess they're digital now too but with a substance inside that rises as the temperature of what you're measuring is higher. So does this get to the density again. Yes.

John: And that's what we cover density before temperature. So say if you have colored alcohol inside that glass the monitor It's a property of the alcohol to expand with increasing temperature so as the atoms and molecules within the alcohol start moving around faster should make sense. They begin to expand and hence they climb up the little capillary within that glass tube and you can just calibrate it. We call that a thermometer. So understand that the mug of hot water and the swimming pool of hot water are at the same temperature. But here's the question which has more energy but but but but they're the same temperature.

Tracy: They're both moving at the same the molecules of water and moving at the same speed but you have a many many more molecules of water in a swimming pool than you do in a mug of coffee

John: And.

Tracy: In a mug of a mug.

John: Yeah. So check your electric bill after you heat up a swimming pool of water to 100 degrees Celsius your energy bill will be out the roof. But if they have the same temperature don't they have the same energy. No no no no no. Energy is the capacity to do work if you want to get those atoms and molecules moving really fast. You need energy to do that. If you have just a couple water molecules you're only going to need a little bit of energy. If you have a lot a lot a lot of water molecules you're going to need a lot a lot a lot of more energy. So it takes a lot more energy to heat up that swimming pool to 100 degrees simply because there's more water to heat up. Another important thing to note about heat is that heat. We call it thermal energy but heat always flows it's it's moving and it moves from an object of higher temperature to an object of lower temperature. So if you touch the fore head of someone who has a fever their temperatures higher. What happens is there will be heat that flows from that higher temperature for head to your lower temperature hand and that heat will be flowing into your hand and you detect that as what we call will will.

Tracy: Warmth.

John: Right now you'll feel that person's for head is warm. But for the person who is sick and has the high temperature and they they feel your hand on their forehand they don't feel warmth. They feel the heat flowing away from their forehead and into your hand. They feel

Tracy: Cools.

John: Cool. Cool. Another

Tracy: They're

John: Made up word.

Tracy: Words.

John: It

Tracy: It's

John: Feels

Tracy: A good one.

John: It feels cool but technically I think that we should call it cool. So if heat is flowing to you you feel that its warmth. If heat is flowing away from you you feel that is cool. Section two point seven. The phase of a material it depends upon how the particles are moving. We can go back to the fist analogy. Okay everybody bring your fists up. I'll make this and put them together and what we're gonna do is represent water in the liquid phase for liquid phase by analogy. You can think of a bunch of marbles in a bag to represent the water you have you're holding a bag of marbles and noticed the marbles will tumble all over one another. So with your fists representing water molecules you got two fists. You got two water molecules go ahead and put them together and now start moving them around each other so that they're tumbling over one another much like marbles tumble over one another within a bag. And what you're doing there is you're representing water in the liquid phase and you know marbles will be able to pour out of the bag. That's how water pours out of a glass. Just think of these tiny tiny tiny particles like marbles pouring out of the glass. And that's what gives rise to the liquid nature. All right great. So you're all tumbling your fists around one another and representing the liquid face. Now what we're gonna do is we're gonna lower the temperature you're at 25 degrees Celsius. What would they look like if that were now 10 degrees Celsius. Would you have those fists moving slower or faster.

Tracy: Well temperature is the measure of how fast particles are moving. Then they will go slower if the temperature went down.

John: Okay. Excellent. So we're now at 10 degrees and your fists are moving slower rate

Tracy: So I want to mention that it's important that the fists are really in contact with each other.

John: Okay. Great. Excellent. So make sure that your fists are actually touching each other much

Tracy: At

John: Like

Tracy: All

John: Time

Tracy: Times

John: Like marbles tumbling over one another in a bag. And as we go from twenty five degrees to 10 degrees the B you should go. Okay. What would they look like at five degrees Celsius.

Tracy: From 10 degrees to 5 degrees

John: Yeah

Tracy: It

John: I

Tracy: Would go even lower.

John: How about 1 degrees Celsius.

Tracy: Even. Below

John: About zero degrees

Tracy: Celsius

John: Which is the freezing point of

Tracy: Water.

John: I bet a number of people out there are holding their fists absolutely still so I'm gonna keep we're going to keep going with this. We're now at zero degrees Celsius. What would it look like at minus 10 degrees Celsius. So you see what's the problem is if you wanted to start moving your fists backwards. No let's not working your fists or moving again. That means it's warming up. What happens when you go below zero degrees Celsius. Is that is it the case that when the water freezes that all the molecules suddenly are not moving anymore. The answer is a resounding.

Tracy: No

John: There's another type of motion that's always happening and it's vibrational. So let's go back to the water at zero degrees Celsius have your fists up next to each other and rather than having them perfectly stopped at zero degrees Celsius have them vibrating back and forth

Tracy: Like

John: This. And

Tracy: So you

John: See

Tracy: What's

John: Happening here at the solid phase is there is still motion but it's a different kind of motion that's now predominant. No longer do you have those molecules tumbling over one another like marbles in a bag. What you have left is just the vibrational motion. Now the molecules are vibrating at higher temperatures too. It just is it's more apparent to us that the molecules are also tumbling over one another. Hold your fists together at

Tracy: Uh

John: And have them

Tracy: Been

John: Vibrating

Tracy: Back

John: And forth

Tracy: And

John: You are

Tracy: At

John: Zero degrees Celsius. Now

Tracy: Let's go

John: Down

Tracy: To

John: Minus 10 degrees Celsius.

Tracy: That's

John: Let's go

Tracy: Good

John: To

Tracy: At

John: Minus 20 minus

Tracy: 50

John: Minus

Tracy: Two

John: 200

Tracy: Hundred

John: Minus two hundred and seventy three point one

Tracy: For

John: Boys when you get to minus two hundred seventy three point one five degrees Celsius. You have reached what we call absolute zero. That is where all motion has stopped. That includes the vibrational motion as well. So let's go in the other direction now. Shelley let's start with our water molecules at twenty five degrees Celsius you want to use your fists to represent water molecules and at 25 degrees Celsius. It's an a liquid phase and the water molecules are tumbling over one another much like a bunch of marbles in a bag. And we're gonna go from twenty five degrees now to 50 degrees and they're going faster and it's 75 degrees. They're tumbling over one another even faster. They're also vibrating too. Now if you can do that. Seventy five degrees Celsius Ninety nine degrees Celsius then 100 degrees Celsius as a liquid. They're still connected but then at 100 degrees as a gas they break apart from one another and they move about wildly and they're no longer in constant contact with each other which explains how it is within the gaseous phase it occupies a lot more. So there it is using your fists to describe from a molecular point of view the different phases of matter

Tracy: Liquid solid. And guess.

John: Right. And when there's a change between any two phases they're terms that we use to describe that going from a liquid to a solid for example is called.

Tracy: Freezing

John: Going from a solid to a liquid is.

Tracy: Melting.

John: From a liquid to a gas.

Tracy: Evaporation.

John: From a gas to a liquid

Tracy: Condensation.

John: From a solid to a gas.

Tracy: Melting. No. No. Wait. Uh hang on hang on. Wait. You got me

John: From

Tracy: Out.

John: A solid to a gas

Tracy: Supplementation.

John: Sublimation. So okay how about a gas to a solid

Tracy: Freezing. Condensation.

John: Gas to a solid. It happens in the freezer. You don't have a frost free freezer in the freezer you're going to see all of the water vapor depositing on the inner surface of the refrigerator

Tracy: All right I found it in the textbook deposition.

John: Excellent. Yeah sublimation in deposition not commonly used but they happen all the time. The snow on to on a mountaintop will sublime. If it weren't for the sublimation of the snow on the mountaintops there'd be a lot more water coming down through our rivers.

Tracy: Is that where the word or the phrase How sublime comes from.

John: Into the atmosphere. And that brings us to the last section of chapter 2 which is on gas laws now understand it gas is the face of matter where the particles are moving about wildly and randomly occupying a lot more volume. There are some traditional laws that describe the behavior of gases. There's Boyle's Law Charles law of gougers law and we can represent these using your mouth.

Tracy: You.

John: Okay so close your mouth. No do not open your lips keep them closed tight. Now pucker up your cheeks. What gas law was that

Tracy: Boyle's.

John: Charles. Or of a god dress of a gorgeous louse pointing out that the more particles we have in there the more volume you have. So as you pushed air molecules into your mouth and your cheeks puckered out that was of Gardner's law. All right. We can use our mounts also to represent Boyle's Law which is the love pressure and volume as you increase the pressure the volume decreases. All right so you've got your puckered out cheeks right now. Right now use your hands to squeeze it and you decrease

Tracy: Chris

John: The volume. Very good. Charles La. I don't think we can represent very well using one's mouth but Charles lies the love volume and temperature. It's this as you lower the temperature guess what happens take a wild guess that to what happens to the speed of those atoms and molecules.

Tracy: They slow down

John: They

Tracy: Is.

John: Slow down and as they slowed down. They occupy less volume.

Tracy: Is in that condensation.

John: Oh you know assuming it doesn't change face So it's useful to use something like helium or oxygen or nitrogen which is a material that maintains a gaseous phase over wide temperature range. Although it's interesting you take oxygen and you cool it down to like minus 200. It turns into a liquid the oxygen turns into a liquid At really really cold temperatures. Now you know

Tracy: Minus

John: Use

Tracy: Two hundred degrees Kelvin or Celsius Celsius.

John: So it's around their 190 I have to look it up. So you take the oxygen and you cool it way down and the oxygen turns into a liquid. It's actually a bluish colored liquid and you know you need oxygen to burn a fire.

Tracy: Yeah. Yeah.

John: So imagine how a fire would feel if suddenly liquid oxygen were poured on it.

Tracy: Happy.

John: Yeah. And so that's how they use liquid oxygen for getting rockets into outer space. The liquid oxygen is a calm dense form of oxygen which means its density is greater. Which means you have a lot of it for a little bit of volume and it's able to sustain quite a bit of chemical reaction to get that rocket into space. So you'll often hear the term locks. It's not like lox and bagel locks in this case we're talking about liquid oxygen which is commonly used for rocketry and so to complete the idea of volume and temperature. These are gas laws and so if suddenly it's transforming into a liquid we're not talking about that anymore. Just while it's in the gaseous phase is when we're talking about the gas laws and the idea with Charles lies you lower the temperature the volume is going to get less. You can take a balloon and fill it with air and put it in the freezer look at it the next day you'll see its volume is less. That's an example of Charles law and what's I think most fascinating from Charles lore is that you can ask the question well at what temperature would it be when the volume finally reaches zero. Because you know as you decrease the temperature the volume gets less and less and less. What happens when it gets to a volume of zero. What's the temperature.

Tracy: Zero degrees kelvin.

John: Zero Kelvin or. Minus two hundred seventy three point one five degrees Celsius

Tracy: Yes. But then where does the material go. How could your volume ever possibly be zero.

John: That's an interesting question.

Tracy: That's a really cool question.

John: Which is one of the reasons why absolute zero is actually an ideal point and not attainable

Tracy: Has anybody ever got anything down to absolute zero.

John: Know that they've gotten really really really really close and things are really funny down there. There are quantum mechanical effects and it's most bizarre.

Tracy: But do most materials at a certain point within that scale of getting down to zero Kelvin go to a liquid phase and then that law doesn't apply anymore.

John: Yes. Helium is the lowest boiling substance we know of in helium boils at 4 Kelvin. I think. The last last last section of chapter two here in conceptual chemistry goes into PV=nRT.

Tracy: **"**Pivnert"

John: That one law summarizes all those three gas laws together into one equation pressure times volume equals number of particles times are which is the gas law constant in temperature. You can read that description of PV = nRT and the ideal gas law right there. The last section there's a calculation corner on PV = nRT that you can play around with for your mathematical pleasure

Tracy: Is it gonna be needed on any exams.

John: That will totally depend upon the nature of your course. Some courses are light on the mathematical flavors some maybe are and of course that's a little more heavy in the mathematical flavor. As with any question you might have ask your instructor. So that's it for chapter two. We just compressed a lot of information into one past half hour but that will hopefully make for a good review for you for an exam coming up and onward to Chapter 3.

John: Our theme music by Zach Jeffrey the frame rap courtesy of Noah Haspray. Other musical flourishes 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 instructors using Conceptual Academy. Thank you for your support. And to you, the hardworking student, thanks too as well for your learning efforts, which we see as the path to making this world a better place. There's a bigger picture. That's good chemistry. Good chemistry to you.

Tracy: Good chemistry to you.